ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVII. No. 10. NEW YORK, SATURDAY, SEPTEMBER 2, 1905. ISSUED WEEKLY

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TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

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CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

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EVOLUTION AND RADIOACTIVITY.

The new developments in physical science have furnished inspiration for a number of notable addresses. This perhaps is natural, for while there are but few of us fully prepared to grasp the significance of the work of Thomson and his school, there is a fascination in the new ideas, threatening as they are to our older beliefs, for they seem to open wide avenues into many departments of natural science which but a year or so ago had but little in common.

The latest instance in which the corpuscle theory has formed the starting point for an interesting suggestion was at the first meeting of the British Association for the Advancement of Science, at Cape Town, South Africa. It was here that Professor G. H. Darwin, the illustrious son of his immortal father, adopting Thomson's idea of atomic construction and the phenomenon of radioactivity, suggested that the life of an atom was merely an instance of evolution—a survival of the fittest. He compared it with the evolution not only of organic life, but of political life as well. Thus, with organic development or with the development of a people, changes are going on constantly, but almost imperceptibly, until a point of instability is reached when a revolution takes place, from which springs a new type of life or of government. Thus, the life of the atom, Professor Darwin says, is merely an evolution; that while it appears to us to be stable and unalterable, a gradual change is going on which will eventually—perhaps millions of years hence—bring the condition of the atom to a point of instability. In other words, a revolution takes place, and a new atom is formed. During this revolution the excess material or energy is thrown out, causing radioactive phenomena, and the remaining portion of the atom settles down to a new stable condition—stable, that is for a while, for the process goes on continually. It is evolution, the fittest only, surviving after each revolution.

THE ELECTRIC MOTOR FOR MINE HOISTING.

The advantages of the electric motor for mine hoisting are well recognized, particularly those due to its easy and safe control. Frequently, also, other advantages may be gained by adopting the electrically driven hoisting engine in place of one driven by steam, since the former may enable an inefficient local boiler plant to be abandoned. But the impression, which still widely prevails, is that with all its advantages the motor-driven equipment costs more to operate. This is not necessarily so. In a paper read recently before the Institution of Mechanical Engineers, of Great Britain, Professor Paul Habets describes an electrical-hoisting plant installed in a Belgian mine, which, upon tests, used from thirty-nine to forty-five pounds of steam per useful horse-power-hour, which is a small amount for a winding engine, and puts the plant on a par with steam. This particular plant uses the Ilgner system, in which the varying loads are partially balanced by a heavy flywheel mounted on the shaft of the motor-generator which supplies current to the winding motor. During the descent of the car, energy is stored up in this wheel, to be used shortly after in starting the load from rest. From his experience with this installation, Professor Habets concludes that the electric-hoisting engine, even if it is not more economical than the best steam-driven equipment, is certainly not more expensive to operate, and the greater facility and safety with which it can be manipulated, the smoothness with which it works, and its much greater flexibility should often make it preferable to the steam-driven machine, even in a case where transmission of energy is not required, and there can be no hesitation in the choice between the two systems when the power must be transmitted over a distance, or where the production of energy for all the work about a mine can be centralized at one power station.

THE GAS ENGINE AS AN AUXILIARY IN ELECTRIC TRANSMISSION.

Under certain peculiar conditions existing in San Francisco, the problem of ensuring a continuous supply of electric power has been solved in an unusual way. The California Gas and Electric Corporation, which owns a number of important hydro-electric generating stations and which furnishes electric power for that section of the country, was anxious to secure as a customer the United Railroads of San Francisco. The supply company has ample power for sale and was able to make attractive rates, but there was one feature of the arrangement which the railroad company viewed with concern. This company operates a large system in San Francisco, and hesitated about entering into a contract which called for shutting down its steam-generating stations because of the serious inconvenience which would be caused to its patrons by a failure of the power supply. No question was raised in regard to the reliability of the supply company's magnificent transmission system, and it was known that the likelihood of a failure was made the more remote by the number of generating stations and transmission lines which the company has already in operation. Yet, notwithstanding the great security thus afforded, it was felt that there was a bare possibilty of a breakdown, and that some plan must be offered by the supply company which would guarantee to the railroad company a continuous supply. The plan which was offered and accepted is described by Mr. John Martin in a paper before the recent meeting of the Pacific Coast Gas Association. It is unusually interesting. One solution of the problem would have been for the railway to maintain its steam-generating stations, but such an arrangement seemed to offer no particular advantages, for if the plants were shut down, although kept in order, it would require an hour or more for steam to be raised in case of the failure of the supply system. On the other hand, if steam were kept up there would be no saving to the railway company in purchasing power. The supply company therefore offered to install a local generating station which could be started at a moment's notice in case of the failure of the long-distance supply, and which would be able to carry the full railway load until the supply could be reestablished. The plan adopted by the transmission company was the erection of a generating station in the city of San Francisco, the generators being driven by large gas engines. The equipment of the station is now well under way. It will consist of three units, each rated at 4,000 kilowatts. The heroic size of these gas engines is well in keeping with the novelty of the undertaking, and there seems to be no feeling of doubt on the part of the engineers as to the success of the plant. Although of such enormous size, it is said that these engines can be started from rest, cold, in about one minute.

The erection of this plant to guarantee a continuous supply of power to the railway, has led to a peculiar situation and has brought about what seems at first to be a surprising determination on the part of the supply company. Since a full operating staff must be maintained at the gas-driven power station, or at least within immediate call, this means that there will be considerable expense involved in maintaining the auxiliary plant. To offset this expense, the power company has decided to operate its gas-engine station, supplying from it a certain portion of the local custom. This is an unexpected outcome of the original plans. The supply company, it will be remembered, wishing to secure an increased load for its hydraulic stations, suggests to the railway company that the latter close down its city stations and draw power from it. This is agreed to provided sufficient reliability be guaranteed, and the outcome is that the steam plants are to be shut down and a gas-driven plant is to be operated in connection with the hydraulic system. Water power and coal are to cooperate to secure absolute reliability. The impulse turbine and the gas engine are to work together on the same system, although separated by over 100 miles of transmission line. We have here a case where coal and water are allies, not rivals as generally supposed. Indeed, at all times each has its proper sphere. Though their boundaries are frequently readjusted as development goes on, so that one often seems to extend into the territory of the other, there are a number of coal mines where hydraulic power is used to operate the electrical mining apparatus.

Another possible solution of the San Francisco problem was, no doubt, thoroughly examined—that is, the use of local storage battery substations. Storage batteries would not only smooth out the railway load and ensure it against a temporary failure of its supply, but would aid in improving the load-factor of the transmission lines. However, the question which probably decided the engineers in favor of the gas-driven station was the cost of storage battery plants large enough to operate the entire system for a number of hours. The gas station can, of course, run indefinitely. It would be interesting, however, to have the various possible ways out of the difficulty compared, and to learn what is the supposed probability of an interruption to the long-distance transmission and how long such an interruption might last. These would, of course, have to be known or assumed before any comparison could be made.

ELECTRIC SIGNS.

The use of electric signs for advertising purposes, common in the larger cities, might be more widely extended and better use made of them in smaller towns where to-day they are rather scarce. Indeed, even in the large cities full advantage is not taken of this new means of attracting attention, which is one of the main objects of advertising. There are many ways of securing novel effects which will catch the eye and draw attention first to the sign itself, and then to the article which the sign advertises. It is not always the most brilliant sign which gives the best results. Too many lamps and too much light may make the sign illegible, and thus defeat its purpose. Small lamps, as a rule, are better, particularly when the sign is near the ground. In a brilliantly lighted area colors may be used with advantage, or some form of flash sign be used, so that it will be distinguishable in the general blaze. One step in advertising an article is to get the advertising sign talked about. The next step, talking of the article itself, is easy. For this purpose there is nothing so effective as a novel electric sign.

THE CENTRAL STATION AND THE COMING AUTUMN.

The shortening days now apparent to every observing central station man constitute a continual hint that the season of heavier business is close at hand, and but little time remains before the extra loads which culminate in the maximum of Christmas week will begin to be felt at the bus-bars in all enterprising communities. While it is now late in the day to provide for extensions on a large scale to meet the anticipated business of the coming autumn, it is still worth while to plan a vigorous campaign for the securing of every dollar's worth of business that the equipment can handle, and to resolve that the fall of 1905 shall be a record-breaker for profitable station output.

There is perhaps no better time in the whole year than the early fall in which to push new business. In times of prosperity the commercial world always takes a stronger grip on affairs soon after the first of September; the iron is hot for the striking home of developments too daring for the listless purchasers and investors of July and August, and then if ever is enthusiasm contagious. A great deal has been written of late in regard to the importance of improving the load-factor and of going afield for new business in the central station industry. In some of the larger cities this work has been pushed with the most creditable energy, but in many others there has been little or no awakening on the part of managers to the possibilities which lie at their very doors. The war between the central station and the isolated plant offers no hope of settlement by any peace conference at present; private plants are being installed every day under the very guns of the central station; steam, oil, and gas engines are still being sold in territory where a vigorous fight on behalf of the electric motor would have won the day; and, finally, consumers in embryo remain by the hundreds to be educated in the incomparable advantages of electricity over all other forms of power.

We recall a manufacturing city of over 125,000 inhabitants whose centre of commercial distribution is certainly not over a mile and a half from the power plant of the lighting company, and yet there are probably far less than fifty electric signs, large and small, in the whole town, while the connected motor load is probably less than twenty per cent of the station capacity. In fact, the electric signs are so few and far between that they are conspicuous by their absence. Hundreds of smoky chimneys testify that the advantages of motor-driving can still be pressed home with profit to both the manufacturers and the central station. Other cases could be cited by the score in which the small motor and the incandescent lamp have failed to displace steam power and the ghastly Welsbach mantle, simply because the local central station people have lacked either the time or the inclination to hammer away persistently at the public until it finally comprehends the commercial and domestic value of the appliances which modern electrical science makes possible. In the telephone field, an aggressive advertising policy, coupled with attractive propositions in the way of rates, has enormously increased central office clientage during the past three or four years. Street railway men know well that there are times when it pays to burn up motors in service for the sake of the total revenue increase, and as for central station equipment to meet the heaviest demands of the fall, the second-hand machinery market frequently offers equipment that can be forced to its limit for several months' service in carrying the peaks of the daily load. Operating economy is well enough in its proper place, but it should not be allowed to obscure the real issue, which is the maximum income consistent with the capacity of the system. The application of the ton-mile principle has earned millions of extra dollars on our great railroads, and the same intellectual cast that sees larger profits in heavier locomotives and larger trains of high capacity cars is needed in the commercial administration of more than a few central station properties to-day.

HIGH-EFFICIENCY CURRENTS FOR INSOMNIA.

Various electrical treatments for the ailing have been developed, many, we believe, giving much benefit to the sick. But it is unfortunately true that the magic of the word "electricity," standing for something mysterious to the general public, has been used by quacks and the dishonest as a means of getting money. Fortunately for electrical science the discovery, recently, of an equally mysterious character has relieved it in part of this burden. Radium is now the great cure-all, the candle toward which the ignorant flutter in the hope that through it lies the way to a happier life, but from which they often fall, badly singed.

There are various methods of treating different ailments electrically, one of these being the use of high-frequency currents for relieving pain or for quieting the nerves. During a treatment of this kind recently in London the patient unfortunately died, and while the death has not been laid entirely to the treatment, it cast a suspicion upon it. The treatment, however, is not without supporters. In a recent communication to the *Lancet* (London), Dr. W. F. Somerville says that he has used high-frequency currents to great advantage in a number of cases. He has not only relieved acute pain, but he has cured patients of persistent insomnia. When properly applied the treatment is not followed by the ill effects attached to the use of narcotic drugs. Dr. Somerville, however, is much opposed to the indiscriminate use of such treatment. He points out that it may be dangerous when applied by the inexperienced, and he thinks that the treatment should be entrusted to qualified medical practitioners only, and that it is unwise and irregular for the general physician to apply it. The latter should send his patients to a recognized institute where the best skill is available. There is no doubt that, while many of the new treatments have benefited humanity greatly, they are not entirely free from danger, and that no physician should employ them unless he has made a special study of them and is familiar with all the effects which may be produced.

Annual Reunion of the Old-Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps.

For the first time in ten years, the annual reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps was held in New York city. The members of these societies gathered at the Waldorf-Astoria, Thirty-fourth street and Fifth avenue, New York city, for the first session of the 1905 reunion at ten o'clock on the morning of Tuesday, August 29. A short business meeting was held by the Old Time Telegraphers' and Historical Association, and the following officers were elected: W. H. Young, Washington, D. C., president, succeeding John C. Barclay, of the Western Union Telegraph Company, New York city; John Brant, New York city, secretary and treasurer.

Immediately after the business session of the Old Time Telegraphers, the business meeting of the United States Military Telegraph Corps was held.

During the afternoon the visitors were entertained in various parts of the city, and in the evening the delegates attended the performance of "The Pearl and the Pumpkin" at the Broadway Theatre.

On Wednesday morning the entire party made a boat trip to Coney Island, where the day was spent in visiting the various amusement resorts of that place.

On Thursday the day was given over to visiting various interesting points about the city, and in the evening the annual banquet was held at the Waldorf-Astoria. Among the invited guests were Colonel R. C. Clowry, president of the Western Union Telegraph Company; Clarence H. Mackay, president of the Commercial Cable and Postal Telegraph companies; Thomas A. Edison, Melville E. Stone, U. N. Bethell, Henry D. Estabrook, J. S. Stuart, J. D. Layng, E. T. Jefferey, William B. Wilson, Belvidere Brooks, John C. Barclay, Thomas W. Goulding, William H. Baker and Thomas F. Clark.

Among the delegates in attendance at this twenty-fifth annual reunion were Charles Selden, telegraph superintendent Baltimore & Ohio Railroad; Campbell Culbert, Knoxville, Iowa; Harry A. Reed, New York city; John Horne, Montreal; William L. Ives; Jules S. Lombard, of Omaha; W. A. Selden and Joseph S. Green.

A letter was sent by special messenger to President Roosevelt, asking that pensions be awarded to the Civil War telegraphers, on the ground that their work in the Civil War was as heroic as any soldier's. Major E. Rosewater was delegated to deliver the letter.

The Franklin Anniversary.

The two-hundredth anniversary of the birth of Benjamin Franklin will be celebrated on a rather extensive scale, if the plans of the American Philosophical Society are carried out. Although the date —January 17, 1906—is some time distant, plans are already being formulated for the holding of proper exercises. The legislature of the state of Pennsylvania has been appealed to by the American Philosophical Society, which Franklin founded, and a contribution has been secured to the extent of $20,000. There will, however, be no lack of funds, as in addition to the legislative contribution there are a number of members of the society, as well as outside interests, that will contribute to the fund necessary to defray the expenses.

Both the state and federal governments will take an active part in the celebration. Governor Pennypacker, who has made an advanced study of the life of Franklin, will preside, and President Roosevelt has been asked to take a prominent part. The world of science will add its quota, and it is expected that a number of foreign scientists, as well as members of the societies to which Franklin belonged, will have delegates present. In addition to this there will be delegates from the press and typographers' associations.

Franklin's experiments began in Boston, and continued, with occasional interruptions, during his entire career. At the time he inaugurated his experiments his researches were the wonder of the then civilized world. It was, however, as a diplomat and a governmental character that Franklin achieved his greatest prominence.

America's Greatest Lead Fields.

It will be a surprise to many people to learn that the state of Idaho produces more than forty per cent of all the lead that is mined in the United States and twenty-seven per cent of the world's output of lead. These interesting facts are set forth in the Idaho building at the Lewis and Clark Exposition, together with a remarkable display of lead ore. Some of the chunks of ore weigh 10,000 pounds, being almost pure lead.

EVOLUTION OF INANIMATE MATTER.[1]

BY G. H. DARWIN.

The subject which I shall discuss tonight is the extent to which ideas parallel to those which have done so much toward elucidating the problems of life, hold good also in the world of matter; and I believe that it will be possible to show that in this respect there exists a resemblance between the two realms of nature, which is not merely fanciful. It is proper to add that as long ago as 1873 Baron Karl du Prel discussed the same subject from a similar point of view, in a book entitled "The Struggle for Life in the Heavens."[2]

Although inanimate matter moves under the action of forces which are incomparably simpler than those governing living beings, yet the problems of the physicist and the astronomer are scarcely less complex than those which present themselves to the biologist. The mystery of life remains as impenetrable as ever, and in his evolutionary speculations the biologist does not attempt to explain life itself, but, adopting as his unit the animal as a whole, discusses its relationships to other animals and to the surrounding conditions. The physicist, on the other hand, is irresistibly impelled to form theories as to the intimate constitution of the ultimate parts of matter, and he desires further to piece together the past histories and the future fates of planets, stars and nebulæ. If then the speculations of the physicist seem in some respects less advanced than those of the biologist, it is chiefly because he is more ambitious in his aims.

The fundamental idea in the theory of natural selection is the persistence of those types of life which are adapted to their surrounding conditions, and the elimination by extermination of ill-adapted types. The struggle for life among forms possessing a greater or less degree of adaptation to slowly varying conditions is held to explain the gradual transmutation of species. Although a different phraseology is used when we speak of the physical world, yet the idea is essentially the same.

The point of view from which I wish you to consider the phenomena of the world of matter may be best explained if, in the first instance, I refer to political institutions, because we all understand, or fancy we understand, something of poli-

[1] Excerpt from the address of the president of the British Association for the Advancement of Science, delivered at Cape Town, South Africa, August 15.

[2] *Der Kampf um's Dasein am Himmel* (zweite Auflage), Denicke, Berlin, 1876.

tics, while the problems of physics are commonly far less familiar to us. This illustration will have a further advantage in that it will not be a mere parable, but will involve the fundamental conception of the nature of evolution.

The complex interactions of man with man in a community are usually described by such comprehensive terms as the state, the commonwealth, or the government. Various states differ widely in their constitution and in the degree of the complexity of their organization, and we classify them by various general terms, such as autocracy, aristocracy or democracy, which express somewhat loosely their leading characteristics. But, for the purpose of showing the analogy with physics, we need terms of wider import than those habitually used in politics. All forms of the state imply interrelationship in the actions of men, and action implies movement. Thus the state may be described as a configuration or arrangement of a community of men; or we may say that it implies a definite mode of motion of man—that is to say an organized scheme of action of man on man. Political history gives an account of the gradual changes in such configurations or modes of motion of men as have possessed the quality of persistence or of stability to resist the disintegrating influence of surrounding circumstances.

In the world of life the naturalist describes those forms which persist as species; similarly the physicist speaks of stable configurations or modes of motion of matter; and the politician speaks of states. The idea at the base of all these conceptions is that of stability, or the power of resisting disintegration. In other words, the degree of persistence or permanence of a species, of a configuration of matter or of a state depends on the perfection of its adaptation to its surrounding conditions.

If we trace the history of a state we find the degree of its stability gradually changing, slowly rising to a maximum, and then slowly declining. When it falls to nothing a revolution ensues, and a new form of government is established. The new mode of motion or government has at first but slight stability, but it gradually acquires strength and permanence, until in its turn the slow decay of stability leads on to a new revolution.

Such crises in political history may give rise to a condition in which the state is incapable of perpetuation by transformation. This occurs when a savage tribe nearly exterminates another tribe and leads the few survivors into slavery; the previous form of government then becomes extinct.

The physicist, like the biologist and the historian, watches the effect of slowly varying external conditions; he sees the quality of persistence or stability gradually decaying until it vanishes, when there ensues what is called, in politics, a revolution.

These considerations lead me to express a doubt whether biologists have been correct in looking for continuous transformation of species. Judging by analogy we should rather expect to find slight continuous changes occurring during a long period of time, followed by a somewhat sudden transformation into a new species, or by rapid extinction. However this may be, when the stability of a mode of motion vanishes, the physicist either finds that it is replaced by a new persistent type of motion adapted to the changed conditions, or perhaps that no such transformation is possible and that the mode of motion has become extinct. The evanescent type of animal life has often been preserved for us, fossilized in geological strata; the evanescent form of government is preserved in written records or in the customs of savage tribes; but the physicist has to pursue his investigations without such useful hints as to the past.

The time-scale in the transmutation of species of animals is furnished by the geological record, although it is not possible to translate that record into years. As we shall see hereafter, the time needed for a change of type in atoms or molecules may be measured by millionths of a second, while in the history of the stars continuous changes occupy millions of years. Notwithstanding this gigantic contrast in speed the process involved seems to be essentially the same.

The study of stability and instability then furnishes the problems which the physicist and biologist alike attempt to solve. The two classes of problems differ principally in the fact that the conditions of the world of life are so incomparably more intricate than those of the world of matter that the biologist is compelled to abandon the attempt to determine the absolute amount of the influence of the various causes which have affected the existence of species. His conclusions are merely qualitative and general, and he is almost universally compelled to refrain from asserting even in general terms what are the reasons which have rendered one form of animal life stable and persistent and another unstable and evanescent.

On the other hand, the physicist, as a general rule, does not rest satisfied unless he obtains a quantitative estimate of various causes and effects on the systems of matter which he discusses. Yet there are some problems of physical evolution in which the conditions are so complex that the physicist is driven, as is the biologist, to rest satisfied with qualitative rather than quantitative conclusions. But he is not content with such crude conclusions except in the last resort, and he generally prefers to proceed by a different method.

The mathematician mentally constructs an ideal mechanical system or model, which is intended to represent in its leading features the system he wants to examine. It is often a task of the utmost difficulty to devise such a model, and the investigator may perchance unconsciously drop out as unimportant something which is really essential to represent actuality. He next examines the conditions of his ideal system, and determines, if he can, all the possible stable and unstable configurations, together with the circumstances which will cause transitions from one to the other. Even when the working model has been successfully imagined, this latter task may often overtax the powers of the mathematician. Finally it remains for him to apply his results to actual matter, and to form a judgment of the extent to which it is justifiable to interpret nature by means of his results.

The fascinating idea that matter of all kinds has a common substratum is of remote antiquity. In the middle ages the alchemists, inspired by this idea, conceived the possibility of transforming the baser metals into gold. The sole difficulty seemed to them the discovery of an appropriate series of chemical operations. We now know that they were always indefinitely far from the goal of their search, yet we must accord to them the honor of having been the pioneers of modern chemistry.

The object of alchemy, as stated in modern language, was to break up or dissociate the atoms of one chemical element into its component parts, and afterward to reunite them into atoms of gold. Although even the dissociative stage of the alchemistic problem still lies far beyond the power of the chemist, yet modern researches seem to furnish a sufficiently clear idea of the structure of atoms to enable us to see what would have to be done to effect a transformation of elements. Indeed, in the complex changes which are found to occur spontaneously in uranium, radium and the allied metals we are prob-

ably watching a spontaneous dissociation and transmutation of elements.

Natural selection may seem, at first sight, as remote as the poles asunder from the ideas of the alchemist, yet dissociation and transmutation depend on the instability and regained stability of the atom, and the survival of the stable atom depends on the principle of natural selection.

Until some ten years ago the essential diversity of the chemical elements was accepted by the chemist as an ultimate fact, and indeed the very name of atom, or that which can not be cut, was given to what was supposed to be the final indivisible portion of matter. The chemist thus proceeded in much the same way as the biologist who, in discussing evolution, accepts the species as his working unit. Accordingly, until recently the chemist discussed working models of matter of atomic structure, and the vast edifice of modern chemistry has been built with atomic bricks.

But within the last few years the electrical researches of Lenard, Rœntgen, Becquerel, the Curies, of my colleagues Larmor and Thomson, and of a host of others, have shown that the atom is not indivisible, and a flood of light has been thrown thereby on the ultimate constitution of matter. Among all these fertile investigators it seems to me that Thomson stands preeminent, because it is principally through him that we are to-day in a better position for picturing the structure of an atom than was ever the case before.

It has been shown, then, that the atom, previously supposed to be indivisible, really consists of a large number of component parts. By various convergent lines of experiment it has been proved that the simplest of all atoms—namely, that of hydrogen—consists of about 800 separate parts; while the number of parts in the atom of the denser metals must be counted by tens of thousands. These separate parts of the atom have been called corpuscles or electrons, and may be described as particles of negative electricity. It is paradoxical, yet true, that the physicist knows more about these ultra-atomic corpuscles and can more easily count them than is the case with the atoms of which they form the parts.

The corpuscles, being negatively electrified, repel one another just as the hairs on a person's head mutually repel one another when combed with a vulcanite comb. The mechanism is as yet obscure whereby the mutual repulsion of the negative corpuscles is restrained from breaking up the atom, but a positive electrical charge, or something equivalent thereto, must exist in the atom, so as to prevent disruption. The existence in the atom of this community of negative corpuscles is certain, and we know further that they are moving with speeds which may in some cases be comparable to the velocity of light, namely, 200,000 miles a second. But the mechanism whereby they are held together in a group is hypothetical.

It is only just a year ago that Thomson suggested, as representing the atom, a mechanical or electrical model whose properties could be accurately examined by mathematical methods. He would be the first to admit that his model is at most merely a crude representation of actuality, yet he has been able to show that such an atom must possess mechanical and electrical properties which simulate, with what Whetham describes as "almost satanic exactness," some of the most obscure and yet most fundamental properties of the chemical elements. *"Se non è vero, è ben trovato,"* and we are surely justified in believing that we have the clue which the alchemists sought in vain.

Thomson's atom consists of a globe charged with positive electricity, inside which there are some thousand or thousands of corpuscles of negative electricity, revolving in regular orbits with great velocities. Since two electrical charges repel one another if they are of the same kind, and attract one another if they are of opposite kinds, the corpuscles mutually repel one another, but all are attracted by the globe containing them. The forces called into play by these electrical interactions are clearly very complicated, and you will not be surprised to learn that Thomson found himself compelled to limit his detailed examination of the model atom to one containing about seventy corpuscles. It is indeed a triumph of mathematical power to have determined the mechanical conditions of such a miniature planetary system as I have described.

It appears that there are definite arrangements of the orbits in which the corpuscles must revolve, if they are to be persistent or stable in their motions. For the purpose of general discussion, which is all that I shall attempt, you may take it that the number of corpuscles in such a community is fixed; and we may state that definite numbers of corpuscles are capable of association in stable communities of definite types.

An infinite number of communities are possible, possessing greater or lesser degrees of stability. Thus the corpuscles in one such community might make thousands of revolutions in their orbits before instability declared itself; such an atom might perhaps last for a long time as estimated in millionths of seconds, but it must finally break up and the corpuscles must disperse or rearrange themselves after the ejection of some of their number. We are thus led to conjecture that the several chemical elements represent those different kinds of communities of corpuscles which have proved by their stability to be successful in the struggle for life. If this is so, it is almost impossible to believe that the successful species have existed for all time, and we must hold that they originated under conditions about which I must forbear to follow Sir Norman Lockyer in speculating.

But if the elements were not eternal in the past, we must ask whether there is reason to believe that they will be eternal in the future. Now, although the conception of the decay of an element and its spontaneous transmutation into another element would have seemed absolutely repugnant to the chemist until recently, yet analogy with other moving systems seems to suggest that the elements are not eternal.

At any rate it is of interest to pursue to its end the history of the model atom which has proved to be so successful in imitating the properties of matter. The laws which govern electricity in motion indicate that such an atom must be radiating or losing energy, and therefore a time must come when it will run down, as a clock does. When this time comes it will spontaneously transmute itself into an element which needs less energy than was required in the former state. Thomson conceives that an atom might be constructed after his model so that its decay should be very slow. It might, he thinks, be made to run for a million years, but it would not be eternal.

Such a conclusion is an absolute contradiction to all that was known of the elements until recently, for no symptoms of decay are perceived, and the elements existing in the solar system must already have lasted for millions of years. Nevertheless, there is good reason to believe that in radium, and in other elements possessing very complex atoms, we do actually observe that break-up and spontaneous rearrangement which constitute a transmutation of elements.

Capitalists of the Pacific Northwest are keenly interested in the discovery of tin in Alaska. Ore which contains more than seventy per cent of the metal, and a number of bars of tin, are shown at the Lewis and Clark fair, in the Nome exhibit in the territorial wing of the United States government building. The owners of the mine claim that they have $25,000,000 worth of the metal in sight.

THE OPERATION OF ALTERNATING-CURRENT MOTORS ON THE SYSTEM OF AN ELECTRIC LIGHT PLANT OF 1,000 KILOWATTS OR LESS CAPACITY.[1]

BY E. H. BEIL.

Within the past few years the use of alternating-current motors has increased largely, and the alternating-current motor is now encroaching on what has been considered, by many, the legitimate field for direct-current motors only, *i. e.*, variable speed, as in crane and elevator work.

Up to within a few months the cost of alternating-current motors has been quite a serious consideration to the power consumer, but now that prices compare favorably with those on direct current, it is very likely that the consumer will demand and obtain, if possible, alternating current in preference to direct-current power, and the effect this will have on the lighting system is of considerable importance.

We will endeavor to consider the experience of our company along these lines.

We now furnish two classes of power service, *viz.*, 500-volt, direct current, and alternating current, single or two-phase. Originally the power service was 500 volt, direct current only, but about six years ago the first alternating-current motor installation was connected, since which time we have been pushing the alternating-current business almost exclusively, except in elevator work, and at the present time have about equal power loads on each service. Nothing has as yet been done with alternating-current elevator motors, all elevators being operated by 500-volt, direct current.

On our alternating-current service, motors ranging from one-eighth to 100 horse-power are connected and very little disturbance to the lighting results from their operation. As a rule, individual transformers are installed, the exceptions being in the smaller-sized motors, say up to three horse-power, which are often connected directly with lighting installations. The service required of the motor, however, determines as to whether it should have its own transformer or not. If, for example, the service is intermittent, the motor being started and stopped frequently, it is bound to affect the lighting unless the transformer capacity is greatly in excess of the load. In many cases this does not matter, as the power is a day and the lighting a night load, the two rarely overlapping.

We have one 100-horse-power, two-phase motor on our alternating-current power circuits, wound for 2,000 volts. This motor is started daily at 7 A. M., run until the noon hour, after which it is again started and runs the balance of the day. Starting is always done under no load condition, and upon inspection of lights on this circuit at times of starting, no change of candle-power was noticeable. In fact, the only installation from which we ever had any trouble in this respect was one in which a one-horse-power, single-phase motor was connected to a somewhat lengthy secondary service, which was already carrying its full lighting load, the customer having stated that the motor would never be used later than 4 P. M. His business, however, exceeded his expectations, necessitating the using of the motor at night, and as the motor was started and stopped frequently, the lighting was badly affected. After putting on a new connection direct from the transformer, no more trouble was experienced.

In many instances motors are started up under comparatively light loads, as in machine shops, laundries, etc., when the motor is connected to a line of shafting from which machines are driven by counter-shafts. In others, the full load is on from the start; a case in mind being that in which a twenty-horse-power motor runs a roller coaster at one of the parks.

The applications of the alternating-current power are quite varied; power in small units being used to drive dental engines, lathes, small air-compressors, presses, shoe-repair machines, cash-carrier systems, foundry blowers, newspaper presses, etc. We have displaced steam power in a laundry, with an installation consisting of one twenty-horse-power, and one ten-horse-power, two-phase, and five two-horse-power, single-phase motors, which have been giving very satisfactory operating results.

The repair item is naturally one of considerable interest and our experience leads us to believe that very few repairs are needed. The total cost of repairs on all alternating-current motors from the time of the first installation up to date, being less than $100; the total horse-power now installed is approximately 700.

As hereinbefore stated, all elevator work is operated by direct—nothing whatever having been done with alternating—current. Polyphase equipment has been on the market several years and we now understand that a successful single-phase elevator motor has been recently brought out. Should this outfit be all that is claimed, it will undoubtedly open quite a field for more business, particularly in such systems as ours when the distribution for the most part is single-phase.

[1] Read before the Ohio Electric Light Association at its eleventh annual convention, Put-in-Bay, Ohio, August 16, 17 and 18, 1905.

The English 220-Volt Lamp.

The *Electrical Review* (London), in its issue of August 14, comments upon Mr. J. W. Howell's recent Institute paper, which criticised some statements made by Colonel R. E. B. Crompton before the International Electrical Congress at St. Louis, September, 1904, regarding the relative efficiencies of English and American lamps. After quoting the figures given by Mr. Howell for the efficiencies of the English and American lamps, as found by him, the article continues:

"There can be little doubt that Colonel Crompton and every one else who has examined into this question must be aware that the lower-voltage lamp is decidedly the better article. This was clearly demonstrated in a case, not so many years ago, between the Westminster Electric Supply Company and the Junior Constitutional Club. The great contention of high versus low-distribution pressure has not, of course, been decided in this country in favor of high pressure on the quality of the different types of lamps, or it never would have been witnessed. It was decided on by other economic considerations to the great advantage of the distributing agency, and to a less extent to the advantage of the lamp consumer; and it now behooves the latter to set off the benefit of a cheap supply of energy against the drawbacks of an inferior class of lamp. He may, however, reasonably expect to receive a gradually improving lamp, and Mr. Howell is working hard to this end."

The Platinum Output.

A recent report from the British consul at St. Petersburg deals with the Russian output of platinum. About ninety per cent of the world's consumption of platinum comes from the Ural district. During 1902 the production was nearly six tons. At the present time there are in Russia several refineries for treating the metal, but the greater part of the product is shipped in its raw state. It is estimated that the output in 1903 was 5.7 tons, and for the first ten months of last year, 4.7 tons. But little prospecting is done, though two nuggets were discovered recently weighing, respectively, 20.5 and 9.5 pounds (Russian). The present price of platinum is about twenty-one dollars per troy ounce.

Electric Power from Welland Canal.

By Alton D. Adams.

CANADA has great opportunities for power development on the Welland canal, and is taking advantage of them. Welland canal parallels Niagara river in general direction, and connects lakes Erie and Ontario across the strip of Canadian territory about thirty miles wide that lies between them. The canal taps Lake Erie at two points, Port Maitland and Port Colborne, and joins Lake Ontario at Port Dalhousie. Port Colborne is about twenty miles up the Canadian shore of Lake Erie from the head of the Niagara river at Buffalo, but owing to changes in the direction of that stream, Welland canal runs only about eight miles from Niagara Falls. From Lake Erie to Lake Ontario Welland canal drops 327 feet, or from elevation 573 feet on Lake Erie to elevation 246 feet above tide water on Lake Ontario. All save about thirty feet of this fall along the canal takes place between Lake Erie and the foot of the escarpment, where the high Niagara plateau breaks down to the low Ontario plain. From the brow of the escarpment to the Ontario plain at its foot the drop in elevation is as much as 270 feet at numerous points.

By conducting the water of the upper Welland canal to the brow of the escarpment, which runs nearly parallel with the shore of Lake Ontario, it is thus practicable to maintain a head of water for power purposes that is nearly twice as great as the height of Niagara falls. If Welland canal had its summit level above the surface of Lake Erie, so that only a very limited supply of water could be obtained, the present great opportunity for the development of electric power would not exist. But the summit level of the Welland canal is at its Lake Erie parts, and the supply of water is limited only by what may be drawn from the four upper Great Lakes. The heads of Welland canal on Lake Erie have their mean elevations of 573 feet above tide-water level, and about 327 feet above the surface of Lake Ontario. From Lake Erie the surface of the canal falls slowly to the head lock near Allanburg, Township of Tharold, County of Welland, where its water stands about 325 feet above the Ontario level. This head lock is the highest of the series through which the Welland canal drops to Lake Ontario.

It will thus be seen that water may be drawn from Welland canal above the head lock and only about a mile from the Niagara escarpment, at a little less than the Lake Erie level, and then by means of a comparatively short canal and pipe line this water may be discharged at the foot of the escarpment, only a little above the surface of Lake Ontario. As the escarpment follows a line some twenty miles distant from the Lake Erie shore it might require a very large and attractive market for power to warrant the construction of a canal from Lake Erie thence, for the sole purpose of developing electric energy. But the canal has been constructed and must be maintained for purposes of navigation, so that in the use of its water for power development the cost of additional construction is the main thing to be considered.

If a power canal from above the head lock to the brow of the escarpment was all that was necessary to supply water to penstocks running to a generating station at the foot, the investment per unit of capacity would be very small. To this investment, however, a material addition must be made to cover the cost of a larger storage capacity. Such a capacity is necessary to avoid fluctuations in the supply of water, due to changes in the level of Lake Erie, and also to enable the full volume of water conveyed by any grant to be drawn from the Welland canal. Grants of rights to divert water from the Welland canal necessarily fix the maximum volumes per second that may be taken, so that navigation may not be hindered, but this maximum volume may be diverted constantly, except in times of low water. Such low water is brought about by changes in the level of Lake Erie. At the head of Niagara river, some twenty miles down the lake from the head of Welland canal, the variation of water level is as much as four feet, from causes other than the wind. A strong west wind piles the water of Lake Erie as much as seven feet above its normal level at the east end of the lake, and a strong east wind lowers the water there by a corresponding amount. When the wind and other causes tending to lower the water level at the head of Niagara river act together, its elevations there may sink as much as nine feet below the normal. Owing to these changes in water level at the east end of Lake Erie, the discharge of Niagara river varies as much as forty per cent, and it seems that there must also be a large variation in the rate at which water can be drawn from the lake by the Welland canal. This fact alone makes it very desirable to construct a large storage reservoir in connection with a power plant operated with water from the Welland canal. Another equally good reason for the construction of a relatively large amount of storage capacity with an electric plant that depends on the canal for water is found in the variable nature of electric loads. Demands for electric light and power have an average that is usually between twenty-five and fifty per cent of their maximum in each business day. Chemical industries offer a more constant load than power and lighting, but the combination of all three classes of demands on an electric system will seldom give an average twenty-four-hour load greater than fifty or sixty per cent of the maximum. As the Canadian government exacts a rent or license fee in proportion to the maximum rate at which water is drawn from the canal, it is evidently a matter of economy to divert water constantly at the maximum rate and store it for the daily hours of heavy load. Such storage is readily provided for by leading a comparatively short feeder canal from above the head lock on the Welland canal to a reservoir near the brow of the escarpment, above the point where a generating station is to be located. From a reservoir thus located penstocks may be run down the face of the escarpment to a power-house at its foot. It this way a water head as great as 270 feet on the wheels may readily be obtained. Under this head one cubic foot of water per second develops almost exactly three gross horse-power.

One important example of power development with water from the Welland canal, that of the plant owned by the Hamilton Cataract Power, Light and Traction Company, Limited, has now been in operation for some time. Water for this plant is diverted from the Welland canal near the head lock at Allanburg, and flows to the forebay at the brow of the escarpment through a canal and storage reservoirs that have a combined length of about four miles. From this forebay four steel pipes, each of 6.5 feet inside diameter and about 800 feet long, run down the face of the escarpment to the generating station. Provision has also been made for two more of these pipes when they are wanted. After passing through the hori-

zontal turbine wheels in the power-house, the water is discharged into Twelve Mile creek which flows into Lake Ontario. In the power canal at the intake weir near the head lock the water level is about 325 feet above that of Lake Ontario, in the forebay at the brow of the escarpment the corresponding level is 306 feet, and the surface of the creek that receives the tail water is thirty-eight feet above the lake. This gives a total head of 268 feet between forebay and tail water, and the effective head is reduced a little by friction in the pipes. From the Dominion government the company above named has acquired the right to divert 700 cubic feet of water per second from the Welland canal. Storage area for this water is provided in reservoirs that cover 450 acres between the intake weir and the forebay.

These reservoirs are designed for a rise and fall of three feet in regular operation, and as one acre-foot equals 43,560 cubic feet, a reduction of three feet in the reservoir level will yield 58,806,000 cubic feet of water for the power plant. At the rate of 700 cubic feet per second, 60,480,000 cubic feet of water may be diverted from the Welland canal per day, and the maximum rate of flow from the canal will add three feet to the depth over the storage area in the course of 23.33 hours. If all the work of each day is done in twelve hours, the average load carried during that number of hours may be twice as great as that which water diverted from the Welland canal in the same time would operate, and the daily change in reservoir level is only 1.5 feet. On the assumption that the combined efficiency of the steel pipes that lead down from the forebay and of the turbine water-wheels is seventy-five per cent, the 700 cubic feet of water per second under the head of 268 feet, which develops 21,147 gross horse-power, will yield 15,860 net horse-power on the turbine shafts. At present the combined capacity of all the turbine wheels in the generating station amounts to 24,300 horse-power, but provision has been made for an increase of this capacity to 38,500 horse-power, and the storage reservoirs have been designed accordingly. It may be noted from these figures that the ultimate capacity of the generating station is to be two and one-half times as great as can be operated with water diverted at the maximum rate from the Welland canal. The stored water, however, will make it possible to run the generating station at its full load during some hours at a time. Energy generated at this station, besides going in relatively small amounts to St. Catharines, is transmitted over a distance of thirty-five miles to Hamilton, Ontario, at either 22,500 or 45,000 volts, as desired.

Cheap electric power has been an important element in making Hamilton the third if not the second city in Canada in the annual value of its manufactured products. Some idea of the extent to which electric power generated by water from Welland canal has been applied to manufacture in Hamilton may be gathered from a few examples. The Canadian cotton mills there use this transmitted water power in electric motors of 582 horse-power total rating. In the Imperial cotton mills the motor equipment aggregates 1,035 horse-power capacity. By the Hamilton Steel and Iron Company electric motors with a total rating of 1,010 horse-power are in use mainly for rolling steel bars and structural shapes. The largest motor equipment operated by transmitted energy and used for manufacturing purposes is that of the International Harvester Company, which has a connected capacity of 1,937 horse-power. While these figures are interesting illustrations of the application of electric power to manufacturing operations, they are also very suggestive of the way in which the Welland canal may be utilized to build up Canadian industries, and of the great demands that may in future be made on it for this purpose.

Aside from competition for the markets of Hamilton and Toronto, which promises to be active, it is very probable that smaller cities and towns of Ontario will want their share of electric water power, and Welland canal offers the cheapest means of its development. It is to be remembered too that the amount of electric power which may be consumed in manufacturing industries is not limited by the population in a given territory, as is the case with lighting service. Thus an electrochemical plant that employs less than one hundred men may consume electric energy at the rate of scores of thousands of horse-power.

New power plants about Niagara Falls must encounter increasing costs and difficulties of construction, as the best locations are already occupied. Along Welland canal and the Niagara escarpment, however, there are numerous opportunities for the diversion of water and the location of generating stations.

Several new plans are now understood to be under way for the construction of plants that will operate with water from the Welland canal. According to one of these plans, for which surveys have been completed, a power-house is to be located at the foot of the escarpment several miles from St. Catharines, and the water supply is to come from the Welland canal through a short power canal and a large reservoir. From this power plant it is said that transmission lines will extend to Hamilton, Toronto and many smaller places. It would perhaps be unsafe to predict a limit to the diversion of water from Welland canal for power purposes, other than the physical capacity of that canal to deliver water near its head lock. The rate at which water will flow along the Welland canal from Lake Erie to free outlets near the head lock depends, of course, on the cross-section and slope of the canal, and on the nature of its bed. It is quite possible also that this bed would not withstand the eroding action that would follow a constant discharge at the maximum obtainable velocity in the canal. Whatever water rights are granted on the canal, the use of sufficient water for all purposes of navigation will no doubt be reserved. All water drawn from the Welland canal must, of course, come from the upper Great Lakes, and lessens by just so much the volume that passes over Niagara falls. Whether the Welland canal has a sufficient discharge capacity to materially reduce the supply of water at the wheel-pits, tunnels, power canals and pipe lines between the upper and lower river at Niagara Falls remains to be determined.

Electric Steel.

Mr. F. W. Harbord, metallurgical expert for the Canadian commission which investigated electrical processes of producing iron and steel, has contributed an article on "Electric Steel" to an engineering supplement published by the London *Times*. In this the following statement appears:

"While on the one hand the extravagant claims urged on behalf of electric smelting—that it will revolutionize the manufacture of structural steels, as at present made in the Bessemer and open-hearth process—may be dismissed as nonsense, the attempts, on the other hand, to prove that it can not compete with the crucible process in the manufacture of tool steels or the open-hearth furnace for many of the higher class steels intermediate between these and common structural steel, may equally be disregarded. The truth lies between these two extremes, and the manufacturer who realizes this and takes advantage of the great possibilities which the electric furnace offers to meet very many of the special steel requirements of to-day, and does so with judgment and knowledge, will without doubt be in a most exceptional position, not only to meet foreign competition, but to more than hold his own against his British competitors."

Hydroelectric Plant of the City of Bruck, Austria.

By Franz Koester.

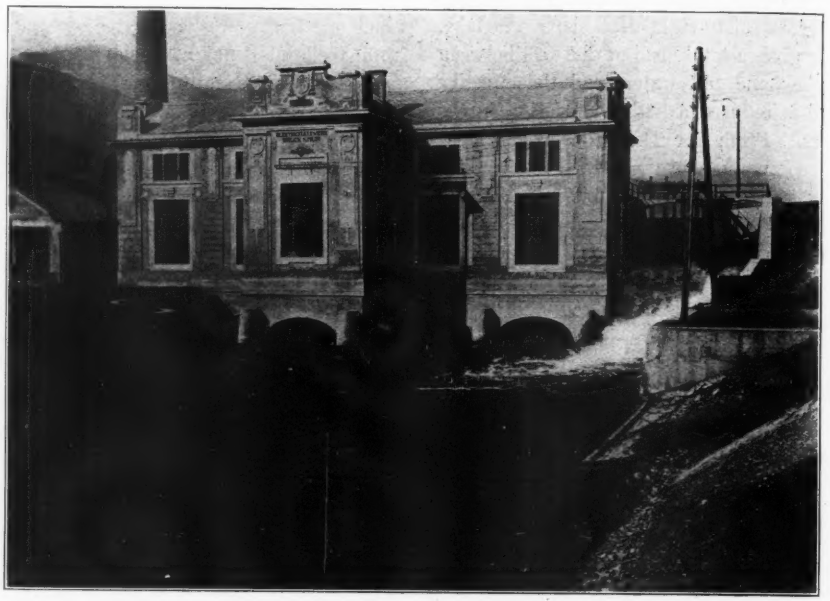
SMALL towns of some 5,000 to 10,000 inhabitants are frequently found in Switzerland, Austria and Germany, having their own water supply and electric power plants. Certain parts of these countries not having coal mines are, however, well supplied with waterfalls from which power is drawn to generate electricity which furnishes the town with light and power. An example of one of the latest plants of this character is here briefly described. This is the plant of the city of Bruck, located at the junction of the Mürc and the Mur, having a population of some eight thousand.

The city is well known to travelers on account of its fine location in the Styria Alps and it also has several small industries. To utilize the water of the Mur a head dam was built some two miles above the city from where a head-race of some 4,900 feet leads to the power-house, while the tail-race is some 1,960 feet in length. With this layout an average head was obtained of 28.5 feet, and furnishing, with a normal flow of water, 2,000 horse-power, while during the greater part of the year from 2,600 to 2,800 horse-power may easily be produced. Owing to the character of the mountain stream Mur and its bed, the water intake system had to be carefully constructed.

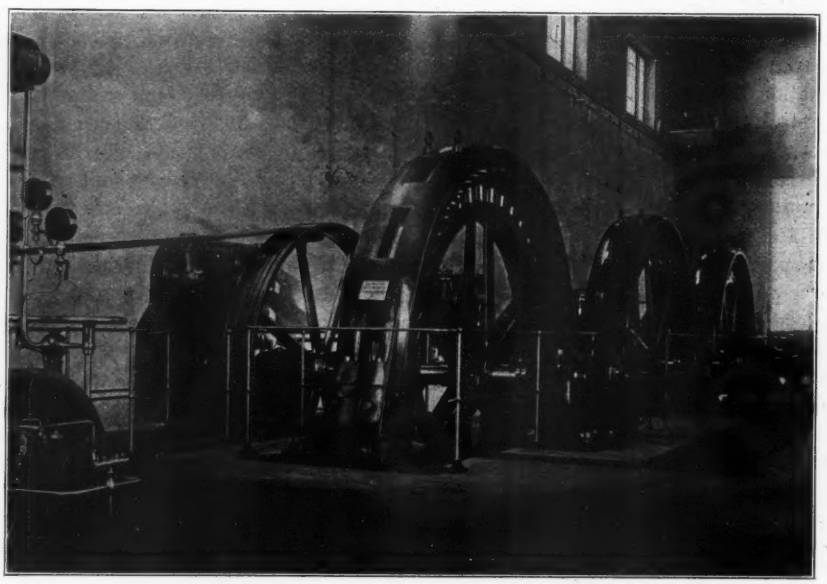
At an angle of some thirty degrees the intake branches off at the left side of the river. At this junction a solid concrete dam of 157 feet in length is built across the river, raising the water level about thirteen feet. The dam is thirteen feet wide and the top well protected with wooden planking. On the left side of the river is an opening thirty-five feet wide between heavy concrete piers for the passage of lumber rafts. While between this and the head-race connection are the sluice gates, three in number, having a total width of 29.5 feet. These three gates, placed between two concrete piers, are held at the centres with steel piles. An iron bridge runs from pier to pier to facilitate the operation of these gates.

As the bed of the river was of loose material extensive pile driving was necessary and these were planked over. In order to prevent sand and gravel from entering the head-race an offset was built in the bed of the intake at an angle of about sixty-five degrees with the axis of the race thus collecting the sand which is guided to a sand-trap and then flows back into the river. The head gate itself is provided with four sluice gates having a total width of 52.4 feet. These gates are also of steel construction and similar to the above mentioned gates in the dam. A bridge is also provided here to operate the gates.

The head-race is an open dish work, partly excavated and partly banked up at a slope of 1.5 to 1. After a run of 4,900 feet the power-house is located at right angles to the head-race. Before entering the collecting basin at the power-house the water has to pass another sand-trap, where the sand is collected and passes out with the overflow running at the side of the power-house down to the tail-race. Steps are provided in order to break the fall of the water in the overflow. One side of the collecting basin is made of a concrete wall, joining the power-house and the bank at the side of the head-race. This wall is 9.8 feet wide at the base and about thirty feet high, thir-



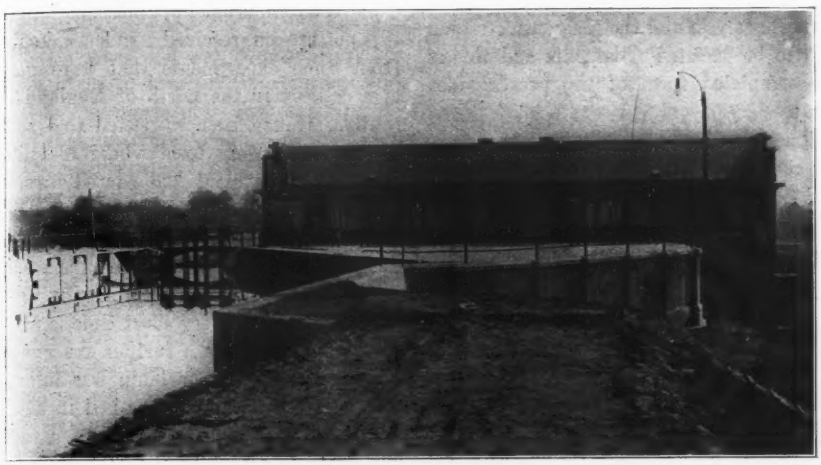
OVERFLOW AND TAIL-RACE. HYDROELECTRIC PLANT, BRUCK, AUSTRIA.



GENERATOR, ROPE-DRIVEN FROM STEAM ENGINE IN EMERGENCY. HYDROELECTRIC PLANT, BRUCK, AUSTRIA.

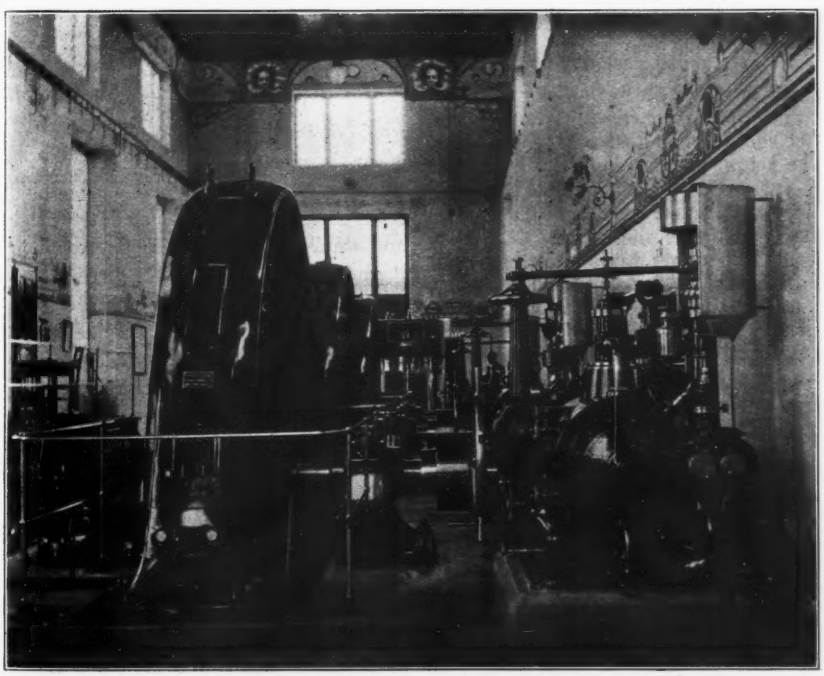
teen feet projecting above the ground level. The head wall of the basin forming the wall of the power-house is also of concrete. The basin itself is protected by a fine screen.

The power-house building is 125 feet long and twenty-six feet wide, and is divided into four sections for the accommodation of four generator units. The entire building is supported on concrete foundations, dividing the tail-race into four sections, one for each turbine. Two of these foundations are extended into the tail-race, supporting an annex used for switchboards, measuring room, etc. The whole building up to the floor level is of concrete, while above that it is of brick. The roof is of wooden construction. A traveling hand-crane is provided running over the generating room.



COLLECTING BASIN AND OVERFLOW, HYDROELECTRIC PLANT, BRUCK, AUSTRIA.

During the construction the excavated earth was removed by means of electrically operated cable lines, while the concrete mixer was also electrically operated. As already stated, the power-house provides for four turbines, three of which are at present installed. The turbines are of the Francis two-wheel type, having an output of 675 horse-power, making 150 revolutions per minute. The efficiency is from seventy-five to seventy-eight per cent, depending upon the quantity and head of water. The turbines themselves are not in the power-house proper, but lie in the water of the previously described basin, while the horizontal shaft extends into the power-house where it is connected by a common disc coupling to the generator shaft. The turbine is provided with a speed regulator of the Ruston type, controlled by a motor under oil pressure. In order to keep the pressure low the piston of the motor is chosen comparatively large, appearing almost as a complete engine. For starting the turbines these motors are provided with large-sized hand-wheels and also with auxiliary levers to bring up the generator and synchronizing with the units already running. The generators are of the revolving-field type, 580 kilowatts, three-phase, 5,500 volts. The exciter is mounted at the end of the main shaft. The high-tension cables are run in a trench in the floor, covered with an iron grating, to the switchboard in the annex.



GENERATING ROOM, HIGH-SPEED STEAM ENGINE IN THE REAR, HYDROELECTRIC PLANT, BRUCK, AUSTRIA.

The switchboard consists of white marble panels on an iron frame. All apparatus is mounted on the back of the board with operating levers on the front. The main generator switches are operated by chains. From the power-house two entirely separate lines are run, one for lighting and small motors and the other for larger motors. There are at present 3,500 incandescent lamps for private use, and a number of arc and incandescent lamps for street lighting and also about 800 horse-power of motors.

In case of an emergency and lack of sufficient water supply one generator may be driven by a high-speed steam engine connected by a rope drive. Steam is generated in a small boiler house containing two boilers located at the right of the turbine plant.

The entire mechanical equipment of this system was designed and installed by the Prager Maschinenbaw-Aktiengesellschaft, successor to Ruston & Company, in Prag, while the entire electric equipment was done by the Siemens-Schuckert Werke, Vienna.

Wireless Telegraph Station at Heysham Harbor, North Lancashire, England.

The Midland Railway, of Great Britain, has been conducting experiments with the Lodge-Muirhead wireless telegraph system, the transmission being from a station at Heysham Harbor, North Lancashire, England, and the railway's steamer Manxman. A description of some of the new features of the land station is given in the *Electrician,* London, August 4. One of the new features is the doing away with an earth connection. The lower capacity surface is actually insulated instead of being constructed of wire net placed on the ground. It consists of a network of wires in the form of a square, and covers an area of 640 square feet. Porcelain insulators are employed to hold it at a height of three feet from the ground. The upper aerial is of similar construction, and is held in position by four masts at a height of eighty feet. All stays have been insulated carefully to prevent damp-effects. The spark-gap is divided into five parts. Choking coils are inserted in the primary of the sparking coil to prevent arcing, and the five parts of the gap are shunted by condensers. The steamer Manxman has been fitted with similar apparatus. Both equipments are tuned to give a wave-length of about 500 yards.

The Efficiency and Life of the Metallized Filament.[1]

The feature of special interest in these new lamps is the improved carbon filament which gives a veritable two and one-half watts per candle lamp—securing a clear gain of twenty per cent in efficiency for the same life and candle-power performance over the present standard 3.1 watts per candle lamp—marking the greatest improvement in lamp quality since the introduction of the treated filament.

It is specially remarkable that this improvement is secured with the ordinary carbon filament subjected to special proc-

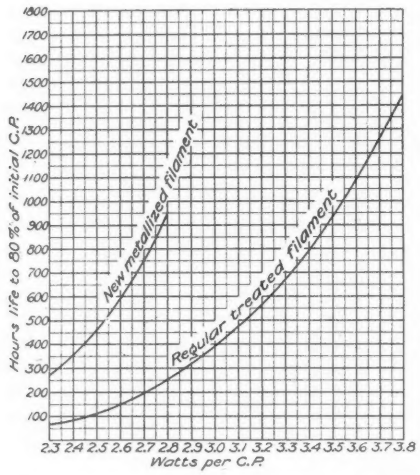


FIG. 1.—CURVES OF USEFUL LIFE AT VARIOUS EFFICIENCIES FOR NEW AND PRESENT FILAMENTS.

esses and not through the employment of any special material or rare metals which might impose new and restricting conditions on present incandescent lighting practice.

This new filament is the result of a discovery made at the research laboratory of the General Electric Company, at Schenectady, N. Y., and has been developed by the laboratory of the lamp works of the same company at Harrison, N. J., where it is now under production. In order to understand the nature of this new filament and the processes employed to obtain it, it will be well to first explain how the ordinary carbon filament is produced.

As is generally known lamp filaments are at present made by squirting a solution of cotton or other form of cellulose through a die forming a thread or fibre which is then hardened and dried. After shaping into the required form for the lamp filament, this is carbonized by heating in a muffle. This produces the raw carbon or base filament as it is called. These base filaments are then separately heated (by passing current through them) in a vessel exhausted of air and containing only hydrocarbon vapor. This coats the filament with a shell or layer of graphite carbon and the filaments are then said to be "treated" filaments and this is the completed form of the present filament.

The new filament is obtained by applying additional processes to the present carbon filament, which include heating the filament in the electric furnace at a temperature of from 3,000 to 3,700 degrees centigrade. This "firing," as it is termed, is performed both before and after treating. This results in producing an exceedingly pure form of carbon having considerably less specific resistance and greater density than the present filament. The process also changes the temperature coefficient from negative to positive.

The present filament (as may be seen in a high candle-power lamp) starts dim and surges up to the full brightness, whereas with the new filament this is reversed, that is, it is very bright at starting and then declines to normal brightness. The practical effect of these new processes on the filament is to make it more refractory, *i. e.,* capable of withstanding a higher temperature for a given rate of deterioration. This enables the filament to give a greater amount of light per unit of surface, *i. e.,* operate at a higher efficiency.

The actual gain in efficiency is twenty per cent over present highest standard efficiency of incandescent lamps. This is a considerable gain, the value of which can probably be better appreciated by reference to curves in Fig. 1. These curves show the useful life performance at various efficiencies for the new and old filaments and the radical improvement in life values is graphically portrayed.

The new metallized filament is dull gray in appearance. It is more stable at high temperatures than the ordinary carbon filament and blackens the lamp bulb much less.

[1] Excerpt from a paper entitled "High Efficiency, High Candle-Power Incandescent Lighting Units," read by Francis W. Willcox before the Ohio Electric Light Association at its eleventh annual convention, Put-in-Bay, Ohio, August 16, 17 and 18, 1905.

At the Gateway of the Mohawk.

The Schenectady Railway Company, of Schenectady, N. Y., has issued an official illustrated souvenir guide of the Schenectady Railway Company, entitled "At the Gateway of the Mohawk." This includes historical scenes, beautiful and picturesque views of natural places in the territory covered by this system. The illustrations are supplemented by a description of each of the places of interest. Some vivid comparisons are drawn, and the book forms a valuable contribution to the historical data concerning this part of the country.

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

THE IGNITION OF COAL DUST BY INCANDESCENT LAMPS.

The idea that the incandescent lamp is a perfectly innocent apparatus, so long as it is not broken, received a rude awakening from some experiments that were made at a colliery in the north of England recently. It had been suspected that some lamps which were fixed where coal dust was rather prevalent had caused fires, so the matter was put to the test. A sixteen-candle-power lamp was embedded in coal dust, in a similar position, and the results watched. Smoke was seen issuing from the coal dust in a very short time, and ignition followed. As a further experiment a sixteen-candle-power lamp was laid on top of a mass of dust contained in a pail with practically the same result—a rapid rise of temperature in the coal dust, followed by ignition if the heat continued. Mr. Hall, one of the British inspectors of mines, has made some experiments which fully confirm those at the colliery in the north. In one case the temperature rose to 370 degrees Fahrenheit in ten minutes, and in another the lamp itself exploded at 450 degrees Fahrenheit in four minutes. A little consideration will show that these results are what might have been expected, if the matter had been worked out scientifically. Under the conditions named, the whole of the energy delivered to the lamp is converted into heat, ninety-five per cent to ninety-seven per cent, at once, and the remainder after having done duty as light, and the heat liberated, is approximately three and one-half British thermal units per minute. The specific heat of coal is 0.3777 average, and the specific gravity 1.25, so that the heat liberated by a sixteen-candle-power lamp should raise one pound of average coal, or about twenty-two cubic inches nine degrees Fahrenheit every minute. But there is a good deal beyond this. Coal dust is a very poor thermal conductor, so that the heat is probably confined to the dust immediately surrounding the lamp, very largely, and the presence of heat in the coal dust, air being also present, immediately produces oxidation of the dust, and with it a further liberation of heat; hence the results obtained. The moral is, of course, do not allow incandescent lamps to touch anything, particularly any matter that is easily subject to oxidation in the presence of heat. Coal dust is not the only thing in a coal mine to which this applies. Mine timbers in dry and dusty mines may give

rise to the same trouble. The experiments throw a good light upon the very troublesome question of spontaneous combustion, to which many coals are subject. It has been pretty clearly shown to be due to oxidation of the coal dust by the ventilating current, heat being liberated which is not carried off by the air current, with the result that the oxidation goes on at an increased rate till the ignition temperature is reached. The experiments show that anything which liberates heat in the neighborhood of a mass of certain coals assists the process of oxidation, and hastens the time of ignition. News comes from New South Wales that metalliferous mines are not as free from inflammable gas as they have hitherto been supposed to be, and the cause is that which has been mentioned above—the oxidation of old-mine timbers in abandoned parts of the mine. The carbureted-hydrogen-gas so generated has been carried by a stream of water through a bore hole into a new working where there were naked lights, and an explosion has followed. News also comes from Saxony that the clay pits of that district give off carbureted-hydrogen gases, and again from the decomposition of old timbers in abandoned portions of the mine. In Saxony, it may be interesting to know, the department of mines has made it obligatory to use safety lamps in clay pits of over fifty feet in depth. So far as the writer is aware nothing of the kind has been met with in any of the numerous clay pits of the United Kingdom.

A COAL MINE WORKED BY ELECTRICITY GENERATED BY "WHITE COAL."

In France, mines of coal are better than mines of gold in many places, and hence it is not surprising to find the anthracite coal mines of La Mure, Isère, worked by electric currents generated by the water power, which is abundant in the district. The current is supplied by a coal company formed for the purpose, and is three-phase, at pressures of 10,000 and 15,000 volts, and fifty periods, transformed down to 500 volts three-phase for the surface of the mines, and further transformed to 185 volts, in the mines, for the underground machinery. The motors are all of the induction type, and range from three horse-power up to 230 horse-power. Distribution on the surface is by naked wires of tinned copper, carried on porcelain insulators, the brackets carrying them being fixed on wooden posts about thirty-five feet high. For the underground service triple-core three-phase cables are used, armored with steel wires. The transformers for the underground service are enclosed in masonry-lined chambers to which only the attendants have access. All motors and transformer cases are connected to earth. The motors are by the Ganz Company, as are also the electric locomotives that are employed for a haulage road one kilometre in length, approximately 1,100 yards. The locomotive receives current, three-phase, from three wires overhead, there being no connection to the rails, by means of three trolleys, at 185 volts pressure. The gauge of the road is thirty-one inches, and it is laid with twenty-eight-pound flange rails. These are the rails usually employed in collieries—flange rails. The coal tub weighs five hundredweight, and carries ten hundredweight of coal. The gradient is one in sixty-four in favor of the load. The locomotive is designed for a draw-bar pull of 5,000 pounds, and is fitted with a Ganz twenty-five-horse-power motor capable of working up to forty-seven horse-power, and of drawing forty loaded tubs at ten miles an hour. It makes thirty double journeys per day of ten hours. The trolley wires are 0.39 inch diameter, and are arranged one in the centre line of the roof, and the other two laterally in the same vertical plane. They are of hardened copper. The locomotive runs in either direction, and rounds points or turn-outs without moving the trolley pole. It is stated to have been running since January 30, 1903, without giving any trouble whatever.

IGNITION OF GAS AT AN ELECTRIC COAL-CUTTING MACHINE.

A colliery manager in Yorkshire has recently been hailed before the local bench of magistrates and fined $25 for allowing gas to be ignited at an electrically driven coal-cutting machine. The cause is stated to have been the absence of an india-rubber ring where the cables enter the machine for connection. This case illustrates one of the difficulties in connection with the use of electricity at the face of the coal, in mines where gas comes away as the coal is worked. The actual spark which ignited the gas passes, the writer believes, between part of the resistance coils; the india-rubber ring mentioned being intended to prevent the ingress of gas into the chamber containing the starting gear. The necessity of a starting switch and resistance is one of the reasons why, in the writer's opinion, three-phase motors are better than continuous for coal-cutting machines. There are serious drawbacks to the use of the three-phase motor, such as the difficulty of obtaining sufficient power to cut through a piece of pyrites, but in his opinion it is better not to attempt to cut through obstacles of that kind, for many reasons. The whole machine is strained in the process, and there must be a dangerous current on the supply cables during the operation. There is a case on record of a disc machine having taken 100 horse-power while cutting through a piece of pyrites and having wrecked the generating engine house in the process. The starting switch and resistance also occupy space that can be very ill spared, and they introduce complications into the apparatus that it would be much better without. As it is, under the best conditions, stoppages are all too frequent. In an eight-hour shift it is very lucky if four hours are actually employed in cutting. On the other hand, this has its advantages from the point of view of the working of the machine, as its parts have time to cool to a certain extent during the stoppages.

It may be noted that there are several new coal-cutting machines being placed on the market. One of these, the Birtley-Falcon, is a modification of the Diamond, in which some of the features of the Morgan-Gardner have also been adopted. The machine has two motors of fifteen horse-power each, arranged to run in series, from the regular power service of the colliery, the disc being in the centre of the length. In place of wheels also the machine runs on skids, those nearest the coal face being divided in the middle, so that the dust may be brought out there. The power is transmitted to the disc by a special helical gearing working in an oil bath, and the resistance is of cast iron insulated by mica. The machine is provided with coupling boxes at each end, it being arranged to run both ways, and the connections are made by hose couplings, the connecting cables inside the machine being conduited. The haulage apparatus for pulling the machine along, as the cut is made, has been slightly modified from that usual. It is operated by an eccentric keyed on the pinion shaft of the driving gear, a rod from the eccentric actuating a link motion which in its turn works the pawls that move the haulage drum. The position of the link motion can be altered while the machine is running, it is claimed, so that the speed of travel can be varied from nothing up to full speed. The whole apparatus is worked from a controller, a modified form of the ordinary tramway controller, with magnetic blowouts. Mr. Austin Hopkinson has also put a machine on the market, very similar to the Morgan-Gardner, at

which he has been working for some time. The old Goolden machine has been revived also by Mr. Peake, the manager of the Walsall Wood colliery, with certain modifications, the most important of which is the suppression of all gearing for transmitting the power from the motor to the cutter bar. The Goolden, it will be remembered, was the earliest form of bar machine electrically driven to be put on the market. The company which handled the machine formed a subsidiary company which undertook to cut coal at a certain price, using its machine. The undertaking was a financial failure, and though some of the machines are still to be found in use, it has practically been withdrawn from the market for many years. The economy in power claimed by the patentees of the Peake machine is very considerable. In fact, the bar machine generally appears to be making good way now.

EARTH AND LEAKAGE IN COAL MINES.

This is a question that is seriously agitating the minds of colliery managers who have electrical apparatus in their mines. In one case reported, a manager said that he had been obliged to place some of his cables in the return air-way, and that it being warm and moist there he had great difficulty in keeping the insulation up to the standard. He was obliged to put the cables in the return, where a break would be very dangerous, in some collieries, because he was badly off for room in the intake. The difficulty has been overcome in some mines by running the cables on the floor. This is a good position, but has its drawbacks, the principal of which is, the cables unless kept constantly in sight are apt to get buried, and an arc formed in any portion would probably ignite the coal dust surrounding it. Several firms have brought out apparatus for showing the leakage current. The details of the apparatus vary, but the main principles are the same, a high resistance connection is made between the positive and negative sides of the service, the middle of this resistance being connected to earth, and instruments showing the leakage inserted in the branches. Leakage on one cable shows on the instrument in the other half of the resistance. A modification of this, introduced by Messrs. Everett, Edgcumbe & Company, has the instrument in the earth wire, and an arrangement for connecting it so that readings can be taken between either cable and earth. The weak point of all these systems is the difficult question, "what is earth" in a coal mine? and there is the further difficulty that if leakage exists to earth on both cables, the two leakages will neutralize each other, wholly or partly; hence the provision of an arrangement for reading the leakage between each cable and earth is of importance, though it adds to the complication of the apparatus.

MERCURY ARC RECTIFIERS.[1]

BY P. D. WAGONER.

A detailed idea of the operation of the mercury arc rectifier circuit may be obtained from Fig. 1. Assume an instant when the terminal H of the supply transformer is positive, the anode A is then positive and the arc is free to flow between A and B, B being the mercury cathode. Following the direction of the arrows still further the current passes through the load J, through the reactance coil E and back to the negative terminal G on the transformer. A little later, when the impressed electromotive force falls below a value sufficient to maintain the arc against the counter-electromotive force of the arc and load, the reactance E, which

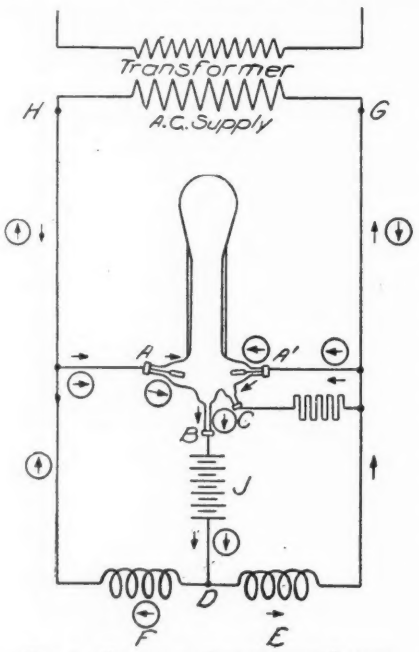


FIG. 1.—RECTIFIER CONNECTIONS SHOWN DIAGRAMMATICALLY.

heretofore has been charging, now discharges, the discharge current being in the same direction as formerly. This serves to maintain the arc in the rectifier until the electromotive force of the supply has passed through zero, reverses and builds up to such a value as to cause A′ to have a sufficiently positive value to start an arc between it and the mercury cathode B. The discharge circuit of the reactance coil E is now through the arc A′ B, instead of through its former circuit. Consequently the arc A′ B is now supplied with current, partly from the transformer and partly from the reactance coil E. The new circuit from the transformer is indicated by the arrows enclosed in circles. The amount of reactance inserted in the circuit reduces the pulsations of the direct current sufficiently for all ordinary commercial purposes. Where it is advisable to still further reduce the amplitude of the pulsations, as, for instance, in telephone work, this is done with very slight reduction in efficiency by means of reactances.

Detailed Description of Commercial Outfit—The commercial rectifier set that has been developed by the General Electric Company, Schenectady, N. Y., for charging vehicle batteries, consists of four essential parts, namely, panel, tube, holder and compensating reactances.

Panel—The panel with material mounted thereon requires a floor space of approximately twenty-four by eighteen inches with a height of seventy-six inches. On it is mounted a voltmeter, ammeter, double-pole switches for connecting the panel to the supply circuit and the load circuit, and the necessary double-pole and single-pole switches for starting and operating the rectifier. Fuses and circuit-breakers are supplied for protecting the rectifier against overloads. A starting resistance is mounted on one of the pipe supports and is connected in multiple with a pilot lamp mounted on the front of the board. The function of the starting resistance is to allow the rectifier to start before throwing on the load. The function of the pilot lamp is to act as a warning after the load has been thrown on that the starting resistance switch should be opened, as the lamp is dark only when the rectifier is operating on the load alone.

Tube and Holder—The tube (Fig. 2) is an exhausted glass vessel, containing two anodes AA, one cathode B, and one starting anode C. The terminals are provided with metal caps which protect the electrodes, thus reducing to a minimum the liability to damage. The leads from the anodes are connected to the compensating reactance and the lead from the cathode to the load.

The holder consists of a moving member mounted on the face of a panel and provided with spring clips for holding the tube. Terminals for connecting the various parts of the tube to the panel are mounted on the panel. (Fig. 3.)

Compensating Reactance—The compensating reactance (Fig. 1) is connected directly across the alternating-current supply mains and is mounted either on the back of the panel, or stands on the floor under the panel. Leads are brought out from the reactance to a dial switch mounted on the front of

[1] Abstract of paper read before the Ohio Electric Light Association at its eleventh annual meeting, Put-in-Bay, Ohio, August 16, 17 and 18, 1905.

the panel. By means of the dial switch the voltage and current may be varied within the limits of the rectifier.

Capacity—The rectifier is now furnished in three standard sizes, namely, ten amperes, twenty amperes and thirty amperes. The above covers rectifiers with a single tube. As many as desired may be operated in multiple by the addition of certain auxiliary apparatus.

Frequency—The rectifier can be adapted to any commercial frequency, and the standard outfits will operate satisfactorily on any frequency from twenty-five to 140 cycles, inclusive. They are designed primarily, however, for sixty cycles, and the maximum direct-current voltage obtainable when operated at twenty-five cycles will be slightly higher, and when operated at 140 cycles slightly lower than when operated at sixty cycles.

Voltage—The rectifier can be furnished to operate on any secondary commercial alternating voltage. The standard outfits, however, are designed for operation on either 110 or 220 volts alternating-current, sixty-cycle, single-phase circuits. It has been found, however, that for a range of direct-current voltage from forty-five to 115, 220 volts alternating current will give the best results, while for a range of direct-current voltage from sixteen to forty-five, 110 volts alternating current is most satisfactory. For practical purposes the direct-current volts may be considered to range from twenty per cent minimum to fifty-two per cent maximum of the alternating-current volts, while the alternating current may be considered as ranging from forty per cent minimum to sixty-six per cent maximum of the direct current delivered. The range of direct-current voltage given in Fig. 3 is obtained by the manipulation of a dial switch mounted on the panel.

Efficiency—As the loss in the arc is constant, the efficiency, of course, varies with the direct-current voltage delivered. For example, tests have shown the efficiency of a thirty-ampere set, operating from a 220-volt, sixty-cycle, alternating-current circuit, to be over seventy-five per cent from one-quarter to full load at a direct-current voltage averaging eighty, and over eighty per cent for direct-current voltage averaging 112. It will be noted from this that the efficiency holds up very high down to one-quarter load, which is not true in the case of motor-generator sets. At the same delivered direct-current voltage, practically the same efficiencies would hold on the twenty-ampere and ten-ampere sets.

The above figures are cited to give an idea of efficiency, as the detailed figures vary with the direct-current voltage, which means with every connection of the reactance.

Power-Factor—Under the same conditions of test as gave the efficiencies

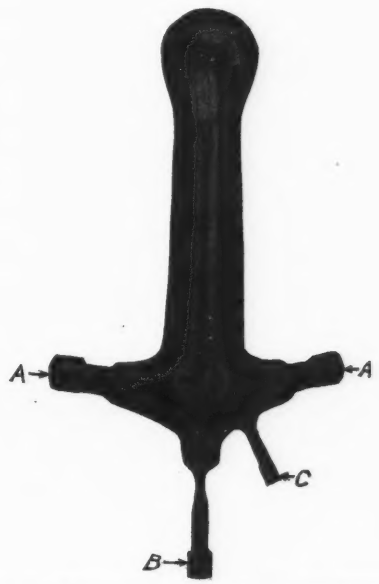


FIG. 2.—MERCURY ARC RECTIFER TUBE, REPRESENTATIVE OF TEN, TWENTY OR THIRTY-AMPERE SIZE.

enumerated above, the power-factor averaged approximately ninety per cent. It is of special interest to know that this high power-factor is practically maintained, whether a low-voltage battery or a high-voltage battery is being charged.

Effect of Wave-Form of Rectifier on Storage Batteries—The question has been

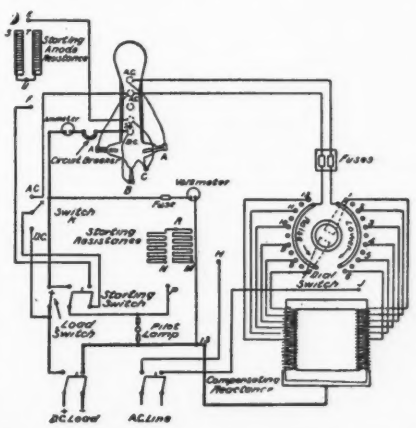


FIG. 3.—DIAGRAM OF CONNECTIONS OF MERCURY ARC RECTIFIER PANEL.

raised as to whether or not the pulsating direct current obtained from the rectifier would have a detrimental effect on storage batteries. This question has been submitted to a storage battery manufacturer and a reply has been received to the following effect: in regard to the effect on a storage battery of charging it through a rectifier, we can not see how it can possibly do any harm; in fact, we should infer that charging through a rectifier would be more efficient than from a continuous current, as the pulsations would, if anything, allow more time for chemical action, gassing would be less, and there would be less loss of energy.

Inherent Regulation—The rectifier has an inherent regulation of from six to eight per cent with variations of direct current. This inherent regulation is a decided advantage. As the storage battery is charged, its counter-electromotive force increases, which, with constant alternating-current voltage supplied to the rectifier, would tend to reduce the current flowing through the battery. As the current decreases, the voltage of the rectifier increases, thus tending to compensate for the increase of the counter-electromotive force of the battery. If this inherent regulation did not exist, the regulating switch would have to be moved more frequently during charge.

Maintenance and Repairs—The only part of the rectifier set that can require maintenance is the tube. The life of the tube under normal operating conditions is at least 400 hours. It will be readily appreciated, from your knowledge of the difficulty of arriving at the average life of incandescent lamps, that a considerable period of test is required to get an average life figure of the rectifier tubes. Tests at present indicate that the average life will be considerably above the figure just cited. This will be appreciated from the fact that we have obtained tests of 4,500 hours on the ten-ampere tubes, 2,500 hours on the twenty-ampere tubes, and 1,400 hours on the thirty-ampere tubes, these tubes still being in operation and having been operated continuously at their rated current. The figure on the thirty-ampere tube is a little misleading, due to the fact that tests have not been carried on as long on the thirty-ampere tube at the rated current as on the other tubes; in fact, not long enough to indicate that the life will be any shorter than the figures given on the ten and twenty-ampere sizes.

As the cost of renewals is merely nominal and the other advantages of the rectifier are so numerous, the question of life is not at all serious, but in any case the saving in cost of energy due to the higher efficiency of the rectifier set over a motor-generator set is sufficient to pay for a new tube in approximately 300

hours, even in the case of a moderately low voltage battery.

Below is a single example of the saving in cost of operation of the mercury arc rectifier set over a motor-generator set, when charging a forty-four-cell battery, the battery being charged in accordance with time and current recommended by the manufacturer.

Motor-Generator Set—First part of charge is at 28 amperes and 106 volts (average) for 5 hours; efficiency of set at this load = 62 per cent; second part of charge is at 12 amperes and 108 volts (average) for 2 hours; efficiency of set at this load = 36 per cent; first part of

$$\text{charge} = \frac{28 \times 106 \times 5}{62 \text{ per cent}} = 23.93 \text{ kilo-}$$

watt-hours from service mains; second

$$\text{part of charge} = \frac{12 \times 108 \times 2}{36 \text{ per cent}} = 7.20$$

kilowatt-hours from service mains; total, 31.13 kilowatt-hours from service mains; when figured at 6 cents per kilowatt-hour = $31.13 \times 0.06 = \$1.867$ per charge.

Mercury Arc Rectifier—First part of

$$\text{charge} = \frac{28 \times 106 \times 5}{80 \text{ per cent}} = 18.5 \text{ kilowatt-}$$

hours from service mains; second part of

$$\text{charge} = \frac{12 \times 108 \times 2}{81 \text{ per cent}} = 3.2 \text{ kilowatt-}$$

hours from service mains; total, 21.7 kilowatt-hours from service mains; when figured at 6 cents per kilowatt-hour = $21.7 \times 0.06 = \$1.302$ per charge; cost per charge motor-generator set, $1.867; cost per charge mercury arc rectifier, $1.302; saving per charge, $0.565.

Assuming the minimum life figure of 400 hours:

Seven hours per charge equals fifty-seven charges during life of tube. Total saving during life of tube = $0.565 \times 57 = \$32.20$.

In this particular example at six cents a kilowatt-hour, the saving is sufficient to pay for a new tube in about 124 hours.

General experience has shown the rectifier to be durable and satisfactory in its operation. If the central station will take up the rectifier for such purposes as described above and push its use, a considerable increase in load will unquestionably result, as well as an improvement in the load-factor.

One of the most important, if not the most important, application of the rectifier is in connection with furnishing direct current for the operation of series direct-current carbon arcs, series mercury arcs, and series luminous arcs or magnetite lamps for series street lighting. The valuable characteristics of the magnetite lamp are doubtlessly appreciated by all of you, as is also the fact that direct current is necessary for its operation. In the past this has been a disadvantage necessitating the installation of revolving machinery, such as Brush machines. The mercury arc rectifier makes possible the operation of the magnetite lamp from the well-known constant-current transformer, the alternating current of which is rectified into direct current by the mercury arc rectifier. Such a system of street lighting has been operated by a central station for some time with remarkably satisfactory results. Systems are about to be installed at other points.

BOOK REVIEWS.

"Steam Engineering." Second edition, revised and enlarged. W. W. F. Pullen. Manchester, England. The Scientific Publishing Company. Cloth. 460 pages. 6 by 9 inches. Many illustrations. Supplied by the ELECTRICAL REVIEW at $1.25.

This is a treatise on boilers; steam, gas and oil engines, and supplementary machinery. The principles of these machines are discussed briefly, frequent illustrations being given to assist in the descriptions. It is intended as a textbook for the use of elementary students in technical schools. It is as well a good book for the so-called practical engineer.

"Practical Alternating Currents and Alternating-Current Testing." Charles F. Smith. Manchester, England. The Scientific Publishing Company. Cloth. XV + 437 + V pages. 5½ by 9 inches. Many diagrams. Supplied by the ELECTRICAL REVIEW at $2.

This is a companion book to the volume on "Practical Testing of Dynamos and Motors" by the same author. It gives first a clear discussion of alternating-current phenomena, and then takes up the various tests of alternating currents and alternating-current apparatus which are usually made in electrical laboratories. Several chapters are devoted to the important subject of current flow in circuits of different types, the effects of capacity and inductance being clearly brought out by the experiments described. One hundred and twenty-four pages of the book are devoted to grounding the student in this most important part of the subject. Following this, tests of the transformer are taken up, to this part of the work sixty-six pages being devoted. In logical order come alternators, synchronous motors, polyphase current, the rotary converter, the induction motor, and analysis of alternating curves. In each main division a goodly number of experiments are described concisely, and the phenomena that they are intended to show are discussed. The book contains a good index, and should be a very satisfactory laboratory manual for alternating-current experiments.

"Electricians' Handy Book." T. O'Conor Sloane. New York. The Norman W. Henley Publishing Company. Flexible leather. 761 pages. 4¾ by 6½ inches. 500 illustrations. Supplied by the ELECTRICAL REVIEW at $3.50.

This is a handbook intended for the non-technical man. It deals entirely with the useful applications of electricity, saying little or nothing about theory. The first chapter explains the elementary mathematics used in simple electrical computations. The question of current flow is then taken up, Ohm's law being explained, and from there on the book is devoted to descriptions and discussions of useful electrical devices. These include primary and secondary batteries, dynamos and motors, alternating-current machinery, switchboards, electrical instruments, electric lights, electric railways, electroplating, telephony, and a short chapter on wireless telegraphy. The electrical worker who has had no opportunity of studying the subject will find in this book a good deal of valuable information which he can understand.

"The Commercial Management of Engineering Works." Second edition, revised and enlarged. Manchester, England. The Scientific Publishing Company. Cloth. XV + 432 pages. 6 by 9 inches. Supplied by the ELECTRICAL REVIEW at $4.

This book is intended for the youthful engineer, the student, or the foreman. The author lays down rules for the proper methods of keeping office and shop accounts. This is done, not by laying out several systems which should be adhered to strictly, but by indicating the best methods of developing a system to meet the needs of any particular case. While there should be no want of system in cost keeping, the danger of overdoing it is pointed out. The book deals with the subject from the English standpoint, but the author studies as well American and Continental systems. It takes up the director's and secretary's offices, the auditor and general manager, draughtsmen, and other subordinate officials. Methods of receipting for materials, passing of invoices, keeping cost accounts, the preparation of estimates, submitting bids, entering orders, and other similar duties are discussed in detail. Methods of filing drawings, the duties of the manager, time-keeping, the stockroom, estimating depreciation and fixed charges are described. A good number of forms for keeping various

records are shown. In an appendix the methods of providing for industrial depreciation are discussed at some length.

"The Honorable Peter White." Ralph D. Williams. Cleveland. Penton Publishing Company. Cloth. 205 pages. 7 by 9½ inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $1.50.

In this biography, prepared by the editor of the *Marine Review*, the development of the Lake Superior Iron Company and the growth of the iron ore trade are described in detail. The book has been prepared after an examination of the manuscripts of the original iron mining companies, and contains a large amount of information not hitherto published concerning the early discoveries of valuable ores in the Lake Superior region. Peter White, who is now a leading citizen of the upper peninsula of Michigan, assisted as a boy in stripping the first iron mine, and wrote the bill of lading for one of the earliest, if not the first, shipments of ore, which was, for that time, the very considerable amount of six barrels. Although nearly sixty years have passed since that time, he is still an active agent in that great iron region. The book relates not only White's services in building up one of the most important industries of the country, but deals as well with those of his contemporaries in this field. It describes also the attempts of the pioneers of that time to establish blast furnaces on the peninsula. That section of the book which deals with the construction of the Sault Ste. Marie canal is particularly interesting. The work was completed in 1855, and the first shipment of ore was passed through in August of that year. Since then this little strip of water has become one of the busiest highways for ships in the world. The development of this region has been truly marvelous. When the mines were first opened the ore was hauled to schooners by mules, ten tons being the average daily delivery. If a thousand tons could be accumulated during the winter for shipment in the spring, the company thought it was doing well. To-day one company has shipped 16,500,000 tons of ore in a single season. The total annual output of this section of the country is over 20,000,000 tons, and it is probable that during the present year it will reach 30,000,000 tons. The methods and the men that brought about this great development are here described, many of the latter being still energetically engaged in the work. Besides being interesting as an addition to the literature of the iron industry, the book is worthy of wider circulation as it deals with an industrial growth which has probably never been equaled in the history of the world.

Photographs of "Dark Flashes" of Lightning.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

During a recent visit to New Mexico on professional business I took some photographs of lightning flashes during an electric storm which took place about eight o'clock in the evening.

Among the pictures secured is the enclosed, which I think you will find interesting. You will note that the upper side of the big flash is bounded by a dark line from which branch off other dark flashes. In addition there are two other prominent dark lightning flashes, one crossing the big flash near the top, and the other one to the left, upper side, of the picture.

I have shown this picture to several of my engineering friends, but all are at a loss to explain the phenomena. Can you enlighten us?

NEWTON W. EMMENS.

Pittsburg, August 9.

"DARK FLASHES" OF LIGHTNING—FROM A PHOTOGRAPH.

[The "dark flash," as it is called, has been observed from time to time, and has caused a good deal of discussion. Photographs have also been obtained of this interesting phenomenon. At first it was explained as a physiological effect, Lord Kelvin being among those who took this stand. An experiment which Lord Kelvin conducted convinced him

PHOTOGRAPH OF LIGHTNING FLASH TAKEN UNDER SIMILAR CIRCUMSTANCES TO THE ABOVE AND NOT EXHIBITING THE "DARK FLASH."

that the effect was simply due to retinal retention; that the image made by a brilliant flash persisted, and when the eye was turned in another direction, was seen in the complementary colors.

This explanation, however, did not account for the photographs, but later these were explained, it was thought, by the experiments of Clayden and Lockyer. They found that when a sensitive plate which had been exposed to a flash of lightning was subsequently exposed to diffused light or to a second flash of lightning, that the image of the first flash was reversed and came out in the photograph as a dark line. The effect was thought to be a purely chemical action of light on the sensitive plate. The photograph is particularly interesting, because it not only shows several of these dark flashes, but a dark flash running side by side with the bright one would, according to the explanation just given, be the photograph of a previous flash whose path was followed throughout by the bright one which immediately succeeded it.—ED.]

The above is the substance of a reply directed to Mr. Emmens, which elicited a further communication as follows:

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I note with interest your explanation regarding the "dark flash," but do not think this explanation holds good in all cases, as you will see by the enclosed photograph.

This photograph was taken during the same storm and prior to the picture previously sent; the camera occupied precisely the same position and the conditions of exposure were alike in both cases so far as the plate, stop, lens, etc., are concerned. You will note that on the picture sent herewith there appear three distinct, long, bright flashes in addition to two small ones (fragments) showing on the left of the picture. This plate was exposed for from fifteen to twenty minutes, during which time there were several bright flashes of lightning outside the field embraced by the lens, but which brilliantly illuminated both the sky and landscape, in addition to those recorded by the plate; yet this plate does not show any "dark flashes." Both negatives were taken on Eastman film, between 8 and 9 P. M. of June 7 this year, at Kingston, New Mexico.

I shall be pleased to send any of your readers, who may be interested in this problem, copies of these pictures and to answer any questions they may have to ask regarding method and conditions under which they were taken.

NEWTON W. EMMENS.

Pittsburg, August 21.

The Municipal Lighting Plant at Detroit, Mich.

At the convention of the International Association of Municipal Electricians, held at Erie, Pa., August 23-25, Mr. Louis Gascoigne, Detroit, Mich., presented some interesting data concerning the physical features of the municipal electric lighting plant at Detroit. The following is an abstract of his paper entitled "Underground Construction."

In 1893, the date of the formation of the Public Lighting Commission, of Detroit, there were 1,277 arc lamps used in street lighting and about 1,500 incandescent lamps used in the city buildings in the centre of the city. It was decided to increase the lamps burning to 1,500 and install machinery for 1,800 arc lamps and 150 kilowatts in alternating-current machinery for incandescent lighting. The plant as designed was to have an ultimate capacity of 4,000 arc lamps and 450 kilowatts in alternating current for incandescent lighting, and as built consisted of seven boilers rated at 300 horse-power each, one sixty-five-horse-power compound, three 340-horse-power triple-expansion engines belted to eighteen 100-light arc dynamos and three fifty-five-kilowatt alternating-current machines, and 1,600 open arc lamps. Each engine was belted by rope driven to four arc dynamos but the design was to have multi-circuit arc dynamos coupled directly, thus a second row of engines, making twelve altogether. The buildings consisted of a boiler and engine buildings between which are the pump, oil and wash rooms and the stack. There was floor space in the boiler room for three additional boilers and in the engine room for one 340-horse-power engine and four 100-light dynamos rope-driven, which would later be replaced with direct-connected units as additional capacity should be needed. However, instead of adhering to this plan, the first increase in machinery consisted of three 100-horse-power engines coupled to 125-light dynamos and two engines belted to the two fifty-five-kilowatt dynamos which were belted to two of the large engines and two 100-light arc dynamos were installed in their places, giving a capacity of 2,375 arcs and 175 kilowatts in incandescent lighting.

That section of the city within one-half mile of the city hall had all wires placed underground. The conduit system for this purpose consists of three lines running north, one east and one west, the latter intersecting two of the lines running north. These are ample for the city business for many years but ducts have been rented for telephone and electric light purposes so that now there is only one duct vacant from the station to one junction pole. The pole-line consisted of two trunk lines, one east and the other west, carrying all overhead wires. These lines consisted of pine poles from sixty to seventy feet long, not less than twelve inches butt, and eight inches top diameter, and now after nearly eleven years, thirty per cent of these poles are still in use. Their principal defect is sap rot which has loosened the pole steps and cross-arms. Of the 300 pine poles removed, about seventy-five were badly rotted at other than the ground line.

For future extensions, the boiler room could be extended if necessary but the engines were planned for direct-connection, leaving room for a second row of engines and dynamos where the dynamos stand. The increase in the number of lamps burning from 1894 to 1904 is nearly 100 per cent, from 1,277 to 2,488, but there has been no increase in boilers and piping. The first increase in machinery was the three direct-connected units and two engines mentioned, making a total capacity of 2,375 arc lamps. This filled all available space in the engine room except that under the switchboard gallery. The number of lamps burning on July 1, 1901, was 2,025, leaving only 350 in reserve or the three direct-connected units. Consequently all the machinery was in use every night and in order to increase the capacity of the plant this space must be used either for temporary unit while one of the 340-horse-power units was being changed to direct-connection and another unit installed where the dynamos were of the installation of such machinery as would give the necessary increased capacity. Four systems were considered: First, twenty-eight direct-connected units of 125 lamps each and five 250-kilowatt alternators equivalent to 6,000 arc lamps or an increase of 3,150. Second, three engines belted to jack shafts from which the twenty dynamos then in use would be belted, also sixteen 150-light arc dynamos, equivalent to 6,400 lamps, 3,550 increase. Third. An alternating-current system, installing five 250-kilowatt alternators connected to the present engines and two 1,700-kilowatt units, equivalent to 9,300 arc lamps, 6,450 additional. Fourth, five 250-kilowatt alternators and one 750 and one 1,700-kilowatt units and eighteen alternating-current motors connected to thirty-six dynamos of the same capacity as in the second case. The second system was the only one the superintendent would con-

sider at first, but when the cost and a sketch of what the plant would be was shown, the plan was abandoned. The recommendation of the electrical superintendent was to adopt direct-current enclosed lamps, adding them as the present dynamos would require new commutators when they could be rewound for the purpose and drive the twenty dynamos with alternating-current motors and connect to the five engines two 250-kilowatt alternators and six 250-light, direct-current arc dynamos and in addition install two 1,000-kilowatt units. As originally installed, the machinery required three square feet of floor space per lamp, the second installation required one and one-fourth and the last, one. This was one of the reasons for adopting alternating current, since the buildings standing on made ground, any extension would mean a heavy expense for piling. Another reason, on account of the plant being located in that section where the wires are required underground, one cable used as a feeder to a substation, could take the place of several circuits. Dynamo and engine investment for the first system was $42.91 per lamp, for the second it was $46.10 and for the last, including transformers, is $34.80. The recommendation was not entirely concurred in. There were added two 800-horse-power engines, two 600-kilowatt and one 175-kilowatt generators, and five arc dynamos were discarded instead of being rewound. When it was decided to adopt the series-enclosed alternating arc lamp, the changes in the plans were instead of using the 175-kilowatt machine as a motor and synchronous condenser, it was installed as a generator, rope-driven from one of the 340-horse-power engines, and the three fifty-five-kilowatt, forty-cycle generators were discarded instead of being rewound for 2,200-volt, sixty cycles.

In order to install the 600-kilowatt unit, the gallery and switchboard must be removed, so a temporary board for the alternating units was set up on the main floor. For a switchboard and transformer house, an alley-way between the engine room and office building was enclosed as a part of the engine room. The transformer house extends across the end of the building and is ten feet wide and fourteen feet high, built of iron and cement. The ceiling is carried five feet out farther than the wall, thus making a gallery fifteen by forty-five feet for the main switchboard. The arc distributing board is in the transformer room wall under the gallery. The main board consists of ten marble panels each forty-six by 100 inches, there being one exciter, three generator, two incandescent, one arc and three substation panels. There are two sets of both primary and exciter busses, the primary busses being two-phase, four wire. There are two four-pole oil switches to each generator panel, so that under ordinary running the busses are in multiple, both switches being thrown. The distributing panels are equipped with double-throw oil switches so that the load can be put on either bus. Instead of regulating for constant potential on the busses, the incandescent system is controlled by auto-transformers. At the same time the alternating lamps were chosen, it was also decided to place the trunk lines underground instead of renewing any defective poles. Consequently the outside section of the city was divided into three parts each to be controlled by a substation. Each single-phase feeder is designed to carry four arc circuits, being supplied with an electromotive force of 5,500 volts at the main station by means of a step-up transformer, thus isolating each group of four circuits. Should it be necessary to isolate a single circuit, there is a one-to-one transformer at each substation for the purpose. Each substation is designed for a total capacity of 1,000 lamps supplied by four feeders from the main station. The switchboard at the substation allows any circuit being plugged on either of two feeders and also an auxiliary bus connected to the individual transformer. Two of the feeders enter controlling panels where, by means of oil switches and plugs, either one can be connected to the 2,200-volt system or to the 5,000-volt system and also connect the 2,200-volt system to the secondaries of a step-down transformer, the primary of which can be connected to the 5,000-volt lines. This was not intended for regular service, but only an auxiliary in case of trouble on the 2,200-volt system as fed from the main station. There are also on the controlling panels an integrating wattmeter, voltmeter and primary fuses. The best panel contains the plugging arrangement for the other two circuits and a voltmeter with switches and cord connections for the purpose of testing the insulation of circuits by means of a battery of 100 dry cells. The arc circuit panels contain fuses, ampere-meters, ammeter, jack, ground jacks and stab switches. Back of the switchboard are the reactance coil regulators and above them are the choke coils and lightning arresters. The choke coils for indoor use consist of fifty turns of wire wound spirally and held together by a spider, and for outside use of flat copper ribbon wound in the same manner and after being taped, mounted on glass insulators.

Each substation panel in the main switchboard contains two double-pole, double-throw oil switches from which the wires go to circuit-breakers and thence to stab switches. These switches are not intended to open the circuit but more of the nature of selector switches, being used in connection with the oil switches for the individual control of the step-up transformers. The instruments on these panels are two power-factor meters, two integrating wattmeters, one ammeter for each transformer and a compensated voltmeter on the feeder containing the regulating transformer. The step-up transformers are of 150 kilowatts capacity, one for each feeder and one in reserve. One transformer in each substation set has ten taps on the primary side by which the secondary voltage can be varied ten per cent. The secondaries of all transformers go to a separate high-tension board which contains besides the connecting cords and jacks, a static ground detector for testing the feeders and an oil switch controlling the reserve transformer. The reason for using plugging jacks and cords is to enable transfers or combinations of either feeders or transformers. Thus it is seen that any feeder to a substation can be connected to the 2,200-volt system and used for the incandescent lighting for the day load, thus avoiding transformer losses, or the incandescent lighting can be supplied at night from the substations instead of by the regular lines. The design is to have the feeders underground from main to substations.

Line construction has not been changed except to overcome induction which was explained at a Chicago meeting of the American Institute of Electrical Engineers, April 7, 1903.

Where convenient, at the time of installation, the lighting commission, fire-alarm telegraph and police signal systems were run on the same poles. About one-half of this combined construction consists of a six-pin arm with the arc circuits occupying the middle pins and the fire and police wires on the outside, the remainder being the commission wires on an arm below the fire and police. The combination of any particular arc and fire or police circuits is only for short distances, one or the other circuit frequently leaving its neighbors on its own poles, and if coming back again it may be to meet another arc circuit of a different phase.

The International Association of Municipal Electricians.

Annual Convention, Erie, Pa., August 22, 23 and 24.

ONE of the most successful conventions of the International Association of Municipal Electricians was held at Erie, Pa., August 22, 23 and 24. The attendance throughout the sessions was excellent, and the discussions on the papers presented were of great interest.

The meeting was called to order by the president, Walter M. Petty, in the meeting room of the Reed House at 10 A. M. Tuesday, August 22, and after a prayer by the Rev. A. C. Ellis an address of welcome to the delegates was made by the mayor, the Hon. R. J. Saltsman. In his address the mayor referred humorously to his occasional duties, one of them being to testify in cases connected with city litigation. On one particular occasion he had posed as an electrical expert, and upon being asked "what is electricity?" had answered, "it is something we throw through the air like a bootjack." This, he said, ended his examination. The mayor extended the freedom of the city to all, especially the ladies, and called attention to the numerous points of interest, some of them relating to the early history of this country.

Vice-president J. B. Yeakle responded on behalf of the association, thanking the mayor for the hearty invitation he had extended.

In his presidential address, which followed, President Petty outlined several schemes for increasing the value of membership, among them being a plan for subdivision of the membership into sections, each devoted to its particular branch of municipal electrical engineering. He proposed that the members of the executive committee be selected with this object in view, making each member responsible for a particular subdivision. Among other things, he referred to the "Question Box," saying it was of great value to all, and should be availed of more than it was.

Following the address, after the appointment of the nomination committee, the meeting adjourned until 2 P. M.

The first paper presented at the afternoon session was by Captain William Brophy, of Boston, on "Suggested Improvements in Fire-Alarm Systems." In the absence of the author, the paper was abstracted by Mr. J. B. Yeakle. After reviewing the various devices now in use and testifying as to their reliability and perfection of workmanship, he continues: "with a system so near perfect it may be asked what room for improvement can be made therein? The answer will be there is very little room for improvement indeed in the fire apparatus proper, unless at some future time it can be made to give instant warning of the existence of a fire at a given location, without the intervention of human aid, but that seems to be far distant, if it ever will come, no matter how devoutly such a consummation is to be wished.

"While the apparatus has been brought to great perfection, not enough attention has been given to the construction of the circuits. I can say without fear of contradiction that ninety-eight per cent of failures of fire-alarm systems are due to the condition of the circuits, and the present overhead system is a relic of barbarism.

"In some cities two or more operating rooms at widely separated points, so interconnected that they will be to all intents and purposes practically one are desirable. One very important reason is that there is no such a thing as a fireproof building, and if fires occur in a fire-alarm headquarters the heart of the system will be destroyed."

Discussion of this paper brought forth the fact that the members had widely different ideas as to the advisability of the poly-station plan. All agreed that the overhead circuits were a great source of trouble, but there also developed the fact that there was considerable difference of opinion regarding the use of bare and insulated wire. Among those participating in the discussion were Messrs. Yeakle, Thompson, Murphy, Berry, and Ellett.

Following Captain Brophy's paper and the discussion thereon, Mr. C. E. Diehl, of Harrisburg, Pa., read a paper entitled, "The Advisability or Inadvisability of Fusing Fire-Alarm and Police Telegraph Boxes." In this paper the author considers the cases where it would be necessary to provide protective devices on fire and police telegraph circuits, and his conclusion is that with the proper protection on the line and at the central station, and with a modern alarm box, which is cut out of circuit when not in use, it is not advisable to add anything more to the circuits that will prove a weakness, and is liable to cause trouble just at the time when it is relied upon. The discussion of this paper by many of the members disclosed the fact that they were unanimous in the opinion that the author's conclusions were correct.

While the gentlemen were in session, the ladies who had accompanied them to Erie were entertained by a carriage drive around the city, and at 7.30 in the evening the members and guests were taken to an amusement resort in trolleys.

At the morning session on August 23, a paper by Mr. C. L. Williams, of Laurel, Mass., entitled "The Erection and Maintenance of Electric Light Plants" was read by title. It was followed by a paper by Mr. A. S. Hatch, of Detroit, Mich., entitled "Electric Light Engineering."

In this paper the author states it is his intention to bring before the members the design and some details of three municipal electric light plants; one that of a small village, another that of a large city and the third that of the celebrated Detroit plant, with which the author has been connected. Of the first plant he said the first cost was to be about $7,000. All expenses would amount to about $1,800 per annum, which allowing about $600 for receipts from commercial lighting, made the cost per light $46 per arc lamp per annum. The larger plant, costing about $415,000, with $84,000 for expenses, made the cost per lamp $42. He then goes into details concerning the Detroit plant.

In the discussion upon this paper Mr. Hatch spoke of other plants which had come under his observation, and gave comparative figures, showing the fallacy of some claims made and also the possibilities of municipal electric lighting. Mr. Cambridge, of Winnipeg, Manitoba, Mr. O'Hearn, of Cambridge, Mass., Mr. Blakely, of Montgomery, Ala., and several others took part in the discussion.

"The Need of a Rigid Inspection by the Municipality" was the title of the next paper read. The author, Mr. T. C. O'Hearn, of Cambridge, Mass., analyzed the conditions existing in many places and said, in part, as follows: the subject of inspection of wires brings up the following questions for consideration: first—what wiring should be inspected? Second—why this wiring should be inspected? Third—how and by whom should it be inspected. Fourth—what means should be at the command of the inspector to enforce the results of his inspection?

Taking these heads up one at a time the author expresses his ideas regarding

them, the final conclusion being that there is a need for rigid inspection of wires, both interior and exterior by municipalities.

Messrs. Hatch, Thompson, Yeakle, Petty, Foster, Donohue, Almon and others discussed the paper, the consensus of opinion being that more attention should be given by the municipalities to this subject.

At 2 P. M. the ladies were taken for a visit to the Old Soldiers' Home.

Upon the calling of the afternoon session to order a paper by Mr. H. R. Allensworth, entitled "The Effects of Electrostatic Influence in Telephone and Telegraph Circuits," was read by the author. He illustrated the subject by means of diagrams and after discussing the causes of electrostatic induction, took up the practical application of devices and methods of eliminating the trouble. He concludes, "the modern telephone cable, made up of twisted pairs arranged in reverse layers, presents the best scheme of transposition in practical use and the writer is an advocate of this style of cable in police and fire-alarm telegraph work. The discussion following was participated in by Messrs. O'Hearn, Hatch and others.

At 4.30 P. M. the members visited the Burke Electrical Works and were entertained by Mr. Burke and others of the company. At 7.30 special trolley cars conveyed the members and guests to Waldmere, where a pleasant evening was spent.

The first business of the session on August 25 was the reading and discussion of a paper by Mr. Louis Gascoigne, of Detroit, entitled "Underground Construction." The writer says, "the ideal construction is the subway, capacious enough for all pipes and cables. This is unfortunately almost impossible because of the great cost." He then speaks of the many conduits which have been devised as raceways for wires, saying that the vitrified conduit is the one most used at the present time. The author's experience, extending over a period of eighteen years, chiefly with iron pipe, leads him to favor that material. It has the advantage that no concrete envelope is necessary, it has more resistance to mechanical injury and its cost of installing is less. These advantages more than offset the first increased cost. Discussing this a member called attention to the fact that in certain soils the iron pipe quickly becomes destroyed, and no amount of treatment appears to remedy the trouble. Mr. Gascoigne stated he had iron conduits in use that had given good service for nineteen years. Messrs. Murphy, Bosch, Claiborne, and others, also discussed the paper.

After discussing the "Question Box," the convention took up the reports of committees. The report of the treasurer showed the finances to be in excellent condition, a substantial balance being carried over to next year.

New Haven, Ct., was selected as the next place of meeting, the exact date being left to the executive committee.

Election of officers resulted as follows:

President—Jerry Murphy, Cleveland, Ohio.

First vice-president—William Crane, Erie, Pa.

Second vice-president—H. R. Allinsworth, Columbus, Ohio.

Third vice-president—B. A. Blakely, Montgomery, Ala.

Fourth vice-president—F. A. Cambridge, Winnipeg, Manitoba.

Secretary—F. P. Foster, Corning, N. Y.

Treasurer—C. E. Diehl, Harrisburg, Pa.

Executive committee (with topics assigned to each member, over which he will have charge during the year)—T. C. O'Hearn, Cambridge, Mass., chairman (inspection); A. S. Hatch, Detroit, Mich. (electric lighting); J. B. Yeakle, Baltimore, Md. (fire telegraph); Louis Gascoigne, Detroit, Mich. (underground construction); W. M. Petty, Rutherford, N. J. ("Question Box"); James Grant, New Haven, Ct. (membership); T. F. Almon, St. Louis (police telegraph); W. H. Thompson, Richmond, Va. (associate members); W. Y. Ellett, Elmira, N. Y. (aerial construction).

Finance committee—W. D. Claiborne, J. F. Macdonald and H. C. Bundy.

Many courtesies were shown the members and guests by the city electrician, Mr. William Crane, and the entertainment committee. After the adjournment a fish fry was served at Four Mile Creek, and a photograph of those present was taken.

The following associate members were represented and displayed their wares for inspection: Gamewell Fire-Alarm Telegraph Company, C. A. Rolfe; American Circular Loom Company; Osburn Flexible Conduit Company; J. Andrae & Sons; Safety Wire and Cable Company.

Tramways in Asia Minor.

The Belgian consul-general at Smyrna, M. J. Duckerts, has submitted a report which contains many particulars regarding possible openings for tramway lines in Asia Minor. The only towns in Asiatic Turkey which have tramway lines are Smyrna, Tripoli and Bagdad. In Smyrna the Compagnie de Quais owns a line three and one-half kilometres long, operated by animals. A tramway belonging to native capitalists continues this line for a distance of five kilometres. In 1903 the municipality of Smyrna inaugurated a branch 1,500 metres in length. At various times the question of constructing a tramway in the interior of the town has been mooted, but the streets in this quarter are so narrow and tortuous that a great deal of demolition would have to be undertaken, the cost of which would be about $160,000. Although this sum would handicap the enterprise, it is thought that it will be successful financially. Suggestions have also been made for extending the present line as far as Vurla and Chesine. The former town is forty-five kilometres distant, and the second something over 100. For these distances steam or electricity would be employed. Until 1902 the use of electricity for this purpose was forbidden in Turkey. Its application to traction and lighting is now allowed in Salonica, Smyrna and Damascus, and the substitution of electricity for animal traction in these cities has been considered, although horses are very cheap.

Tripoli is divided into two parts—the harbor and the inner town, which are three kilometres distant from one another. They are now connected by a tramway.

Bagdad is connected with Kamazene by a tramway eight kilometres long, which was constructed in 1871. The line has been partially rebuilt. The scheme of constructing another ten kilometres long is said to be well advanced.

In regard to the possibility of future extensions, M. Duckerts says that it is not impossible to extend the Smyrna system, although it would be very expensive. The town of Broussa is hilly, but the grades are not insurmountable. In Aleppo the streets are narrow and tortuous, and a tramway would be out of the question. In a modern section of this town, however, some of the thoroughfares are fairly wide. In this quarter the houses are scattered, so that a tramway might be constructed. Bayruth is a hilly town, ill adapted to tramway construction, though it is thought that the grades might be overcome. The same remarks apply to Jerusalem. Damascus seems, to M. Duckerts, to be the most favorable field for a tramway enterprise. The town is very scattered, the Hawran railway station is very remote from the Bayruth station, and traffic is very heavy along the whole route between the two. The town of Bassorah is connected with the harbor by a paved road three kilometres long, admirably adapted for a tramway. In most of these towns carriages and animals can be hired at very low rates, and their competition with tramways would probably be serious.

WASTE PRODUCTS OF A CENTRAL STATION.[1]

BY J. A. BENDURE.

The utilization of exhaust steam due to the operation of electric lighting and power plants is an idea which first came into use in 1889. As the growth of the utilization of exhaust steam for heating purposes progressed, the possibilities of large profits from this enterprise became more and more apparent to the central station managers, and during the past few years the growth of their business has been exceedingly rapid. Naturally, many experiments have been made along the lines of construction, and methods of delivery of heat in the exhaust steam to the building to be heated, and to-day it is a well recognized fact that the system best adapted for the delivery of exhaust steam is the one which is the most flexible, the one in which the most accurate records of delivery cost and use of steam by the various customers are obtainable, and which is adapted to serve heat to any form of heating apparatus, with the possible exception of stoves and furnaces and grates, which is now found in the various buildings of any city. The delivery of steam itself seems to answer this condition, as the commodity without change can be delivered to the customer's radiators direct, requiring no alterations in his present piping, and requiring only the installation of a steam trap, and for the highest economy an economizing coil, to utilize the heat in the water of condensation accumulating in the various exposed pipes and radiators throughout the building heated; or, the steam can be delivered to a hot-water heater designed to heat the water in a circulating system of a building which is piped for hot-water radiation, thermostatic control being applied to the temperature of the water circulated.

The various vacuum systems now found in buildings can be utilized and, if the customer desires, an atmospheric system can be installed. The installation of the radiation can be so accomplished through the use of top and bottom connected cast-iron radiation, to supply which a ported or graduated type of supply valve can be used in such a manner that from one-fifth to four-fifths of any radiator can be heated at the will of the occupant of the room, thus ensuring the greatest economy possible in the quantity of steam condensed. In this latter mentioned system of house-piping no economizing coils or steam traps are required, and the maximum amount of pressure that the central station will have to deliver at the wall of the building to be heated is eight ounces.

During eight months of the year steam heat is a more staple article than either electricity or gas, so there need be no anxiety on the part of a station manager as to securing an output for his exhaust steam. The income per mile of steam mains is far in excess of either gas, electric light or water, and a very large majority of buildings pay from three to four times as much for heat than for light, water and power combined. Chiefly, success in this branch of the enterprise depends upon the following: a properly constructed plant, volume of business, proper method of charging for steam supplied, and efficient management.

Charging by meter is fully as important, if not more so, in the sale of steam than in the sale of gas or electric current.

One company with whom I have corresponded and which has kept close records of matters connected with the heating business, and which has 125 residences, sixty-six business blocks, six churches, four schools, one hotel and a post-office building connected to its lines, reports as follows:

The average amount of steam required per thousand cubic feet of space was as follows:

	1902-03. Lbs.	1903-04. Lbs.	1904-05. Lbs.
In residences heated	10,639	12,843	11,280
In business blocks	6,923	8,045	7,948
Schools	6,416	6,107	5,319

Schools were closed during the season of 1903-04 for about a month owing to fever epidemic.

	Lbs.	Lbs.	Lbs.
Churches	4,051	3,663	3,305

Another company located in the Central West:

	1902-03. Lbs.	1903-04. Lbs.	1904-05. Lbs.
Residences	9,400	9,616	8,672
Business blocks	7,030	7,938	6,716
Hotels	5,410	9,539	6,009
Churches	2,480	2,443	.....
Public buildings	....	6,114	5,538

Another plant 100 miles further west reported:

	1904-05. Lbs.
Residences	6,255
Business blocks	4,383
Hotels	7,265
Schools	4,806
Public buildings	4,896

The factor of the greater use of steam of the first named western city over the latter per 1,000 cubic feet of space heated in all of the different classes of customers was probably due to the fact that in the former case the steam was sold for forty-five cents per thousand pounds net, and in the latter case sixty cents per thousand pounds, and under the higher rate the customers used a less amount of steam and were equally satisfactorily heated and at a less cost per 1,000 cubic feet of space heated. You will also note that the quantity of steam used per 1,000 cubic feet of space heated is greater in residence districts than in the business districts. This to a large extent makes up the difference in cubic feet of space heated to the lineal foot of mains installed.

The method of construction, including method of insulation devices for taking care of expansion and contraction, provision for dry steam being taken from the top of the mains, and means accomplished for relieving the mains of any accumulation of water of condensation and the measuring of this condensation to determine the proportion of steam condensed in the street mains to the amount discharged into the mains, is one of the first and most important features to be considered by a company about to go into central station heating. Upon these factors depend the life of the plant, satisfactory service, cheapest of delivery, and the effects upon the operation of the power plant.

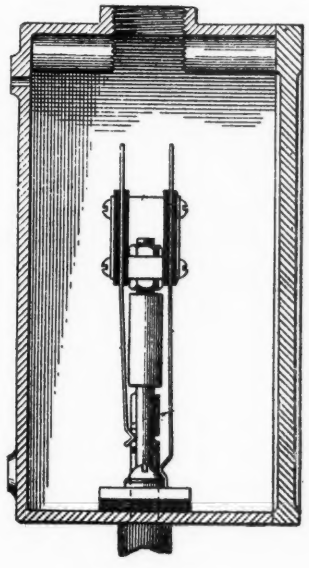
As a further reason for going into the district steam heating business, it is a well-recognized fact that the ability to supply steam has often enabled a company to secure contracts for light and power which it would not otherwise have obtained. This then in turn increases the load and the profits from the electric end, and also increases the amount of exhaust steam that can be sold for heating. While it is true that the demand for heat comes about the same time of the year as comes the demand for light, yet it is also true that it may not come at the same time of the day that the plant is producing its maximum amount of exhaust steam; in other words, the lighting peak and the heating peak may not be coincident, in fact, there is no reason why they should be.

While it may be possible to compare with daily and monthly load curves of a central station, a hypothetical curve representing the amount of heat required by a building to give dimensions and thus estimate how much live steam can be added, the result is at the best only an approximation. The only safe and reasonable rate is that based on the cost of supplying heat direct from the coal pile, or, in other words, on a live steam basis, and any exhaust steam available with the rates thus fixed can of course be used to a very decided advantage.

[1] Abstract of paper read at the annual convention of the Ohio Electric Light Association, Put-in-Bay, August 16.

Electrical Patents.

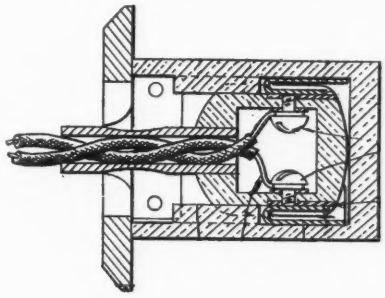
Frank R. McBerty, of Evanston, Ill., has assigned the entire interest in a patent (797,526, August 15, 1905) obtained by him on an improved switch to the Western Electric Company, Chicago, Ill. The object of the invention is to provide an improved construction whereby the switch may be protected from injury and from operation by other than authorized persons. The invention is particularly applicable to spring-jack switches and contemplates an enclosed switch with a guard for preventing access thereto, the guard being locked in position and arranged to be released by a key carried upon the plug or removable part of the switch. A loop-plug is employed and a spring jack, the spring jack having corresponding springs adapted to engage corresponding contact portions of the plug. A guard for the orifice of the spring jack is slidably mounted in the framework thereof, one of the contact springs normally engaging the guard to lock it in position, the guard having a keyhole therein. A key portion



Electric Switch.

is formed at the tip of the plug and is adapted for insertion into the keyhole and to disengage the contact spring from the guard, the guard being slid to the rear in inserting the plug. A detent is carried by the guard and is adapted to engage the plug, whereby in withdrawing the plug the guard is pulled back to its normal position and locked by the spring.

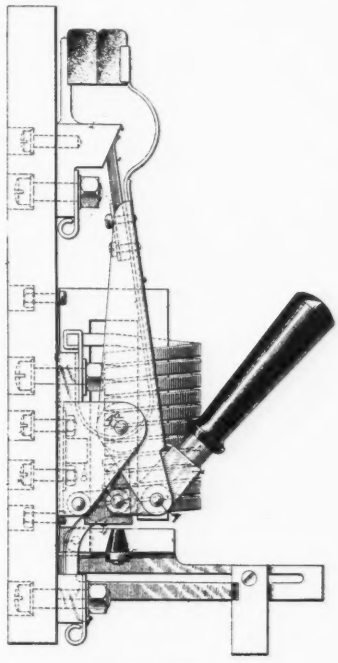
Henry G. Osborne and Edward Richter, of New York, N. Y., are the inventors of a plug box for electric circuits (797,215, August 15, 1905). The object of the invention is to provide an improved device of the above character which is simple in construction and operation and which is provided with spring doors which swing both inwardly and outwardly, the doors swinging inwardly when the plug is inserted and being also so formed that they swing outwardly in the operation of pulling out the plug, a further object being to provide a plug box for electric circuits and a plug for operation in connection therewith, both of which possess novel features of construction. In carrying out



Plug Box for Electric Circuits.

the invention the plug box is provided with spring contact devices at its opposite sides, the plug being adapted to be inserted into the plug box, the plug also being provided with contact devices at its opposite sides which engage the contact devices at the opposite sides of the box, the plug being also provided at one end thereof with a tubular handle through which are passed circuit wires. Devices are located in the transverse opening therein for connecting the circuit wires with the contact devices at the opposite sides of the box, the plug also being provided in its opposite sides and at right angles to the transverse openings therein with side openings which communicate with the transverse opening.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., is the assignee of a patent (797,048, August 15, 1905) recently granted to Harry P. Davis, of Pittsburg, and Arthur B. Reynders, of Wilkinsburg, Pa., on an improvement in circuit-breakers. The object of the present invention is to provide a circuit-interrupting device which may be utilized both as an automatic circuit-breaker and as a circuit-closing switch, which is inexpensive to manufacture because of the minimum number of simple parts comprising it, and which is also light, compact, durable and effective in operation. The circuit-breaker comprises a base having two sets of contact terminals and two sheet-metal brackets, sheet-metal arms hinged to the brackets and having main and shunt contact terminals. Sheet-metal toggle links loose and lock the arms. A coil is employed having an armature, the tripping projections of which have substantially uniform movement to trip the locking levers simultaneously when



Circuit-Breaker.

both are free from manual restraint, but either of which will act alone to trip the corresponding locking lever when the other locking lever is manually held in closed position.

The Effect of Temperature on Insulating Materials.

A report has been issued by the British Engineering Standards Committee which deals with the effect of temperature on insulating materials. A series of measurements was conducted for the committee throughout temperature ranges from seventy-five degrees centigrade to 150 degrees centigrade. Various disruptive voltages were employed, and the resistance and mechanical properties of the materials were investigated. The report shows that the electrical properties of materials do not seem to be influenced greatly by exposure at the temperatures given, but that the material perishes on long-continued heating. Attention is called to the great increase in resistance which takes place in insulating materials due to the removal of water at 100 degrees centigrade.

Reviews of Current Engineering and Scientific Literature.

Austrian Electric Railways.

Some statistics are here given covering the Austrian electric railways up to the end of last year. The total mileage in operation at that time was 360. The largest system is in Vienna, where the state railway companies have in service about 184 kilometres. The city of Prague has a system of forty-four kilometres, not including lines connecting it with other towns. The same should be said of Vienna, where there is a suburban line forty-two kilometres in length. There are operated on these roads twenty-four locomotives of different types. There are 2,914 passenger cars and 366 freight cars, making a total of 3,280 cars. There are apparently four track gauges in use in Austria, varying from ninety centimetres to 176 centimetres.—*Translated and abstracted from Zeitschrift für Elektrotechnik (Vienna), August* 13.

Successive Improvements in German Train Lighting Systems.

Monsieur C. H. Jacquin describes here the improvements in the train lighting systems, as adopted in the German railroads. Little or nothing was done in electric train lighting in that country until 1901, when a serious accident occurred and a number of deaths were attributed to the gas lighting system of the train. Electric lighting was then tried in a tentative way, several trains being equipped with storage batteries. Another system now being tried was invented by Buttner. In this there is no moving regulating device. The voltage at each lamp is instead maintained constant by means of a ballast similar to that employed in Nernst lamps. The cars are equipped with thirty-two storage batteries each, the voltage of which varies from sixty-two to eighty. The fall of voltage in the regulator varies automatically from fourteen to thirty-two volts, maintaining a constant pressure of forty-eight volts pressure at the lamps. Each lamp requires its own regulator. The system was first tried in April, 1902, on a train running between Berlin and Sassnitz. The train was dynamo-driven by a small turbine of fifteen horse-power. The latter was discarded later for a dynamo, placed in the baggage car and driven from the axle. Buttner also proposes using electrolytic rectifiers for preventing a reversal current through the batteries. The author also discusses the Rosenburg dynamo, which by means of auxiliary brushes becomes self-regulating, and gives a constant voltage through a wide range of speed.—*Translated and abstracted from La Revue Électrique (Paris), July* 30.

The Prevention of Overhead Accidents.

The method used by Mr. Robert N. Tweedy for keeping up the overhead system of the electric line for which he is engineer is here described. This includes continuous, careful inspection, besides the tests made at the power-house for leakage and insulation, which are taken nightly. The whole system is gone over periodically by inspectors on a tower wagon. In this way every insulator, every hanger and span wire is examined. All insulators are tested by flashing. For this purpose a wooden fork having two prongs is used. Upon this wire is tacked, leaving two bare ends. A third wire, insulated, is carried down the handle and makes contact with the track. Fuses are inserted in the two branches of the circuit, and a push-button employed to make contact. To test the insulation of a hanger one end of this wire is connected to the span wire, while by means of the third insulated wire connection is made to the rail. If the hanger is defective a circuit is thus established, but the burning out of the fuse prevents a short-circuit at the station. To test the span wire insulators the span wire is connected to the trolley wire, thus throwing the full voltage upon the span insulator. If the latter is defective the fuse on the testing device blows, and opens the circuit. All sections of the trolley wire are inspected during this trip. Wherever the wire has been worn considerably it is measured by gauges, and if below a certain minimum is replaced. On curves and other points where excessive wear occurs at the hanger ear, these are removed from time to time and replaced with longer ears so as to cover up the injured part. The trolley wire is inspected throughout its entire length to prevent burns or other injuries. These inspections are made once a week on the principal roads, and about once in four weeks on the less important lines. For reporting work a blank is provided, on which all repairs are noted. As soon as a report is made of the jumping of a trolley which caused an opening of the circuit-breaker at the station, the apparatus on the car and the line are examined. All parts of the overhead equipment which can rust or on which dust can collect are cleaned during the inspection. Poles and other parts are painted twice a year. The linemen also have charge of the section pillars, and see that they are kept clean and that spare fuses are available.—*Abstracted from the Electrical Review (London), August* 11.

The Influence of the Electrolyte on the Operation of the Aluminum Rectifier.

Although many discussions of the behavior of aluminum cells have been published, the effect of the electrolyte upon its action seems to have been somewhat neglected. Dr. Franz Peters and Dr. A. E. Lange give here the results of investigations into this phase of the cell. The apparatus consists of a glass jar open at the bottom, which opening is stopped by means of a rubber cork. An aluminum tube inserted through the cork forms one electrode; the other electrode is a plate of lead. The aluminum used was ninety-nine per cent pure, and the surface was polished by means of a scratch brush. The source of the current was a 120-volt lighting circuit, though in some of the experiments voltages as high as 150 were employed. The voltages were regulated by means of a simple wire potentiometer. The method of conducting the experiments was to apply voltages increasing in steps of four or five, observing the current flow and coating when the interruption of the current took place. The voltage was then increased further by steps until the cell ceased to act as an interrupter. This value was called the critical voltage. In each case the temperature of the cell was noted, as this is an important feature of the combination. The electrolytes used were various acids and their salts. It was found that the ammonium and calcium salts of dibasic organic acids showed higher critical voltages than the corresponding salts of monobasic acids, and a much better action than the salts of dibasic sulphuric acid. According to the researches, it appears—at least for acids of lower basicity—of much importance whether the acid be organic or inorganic. Experiments conducted with many salts of acetic acid show that the action of the cell depends upon the cation present. The same is true of other monobasic acids. Experiments made with the so-called aromatic series of organic acids, which were

suggested by Pollak, showed that the presence of one or more halogen or amido groups in these acids affected the action of the cell deleteriously. The action of the aromatic acids is improved by an oxy group. It has been said that the action of any cell in which the electrolyte contains a mixture of salts is dependent upon that salt giving the poorest results. This is not entirely true, for the amount of the various salts affects the performance of the cell; for example, with a mixture of barium and strontium acetates, the ratio being twenty to one, the critical voltage is sixty-five. It decreases with decreasing ratio until it becomes fifteen volts with a proportion of two to one. The temperature of the anode also decreases, though not as rapidly as the critical voltage. These researches, while not complete, indicate that the electrolyte has an important influence on the performance of the cell.—*Translated and abstracted from the Elektrotechnischer Zeitschrift (Berlin), August* 10.

General Education for Engineers.

The desirability of giving engineering students a broader general knowledge is here discussed by Professor Charles D. Marx. The author thinks that the graduate of a high school who takes up engineering studies should be required to broaden his intellectual horizon before beginning his professional work. However, the difficulty of bringing this about is great. It is not thought that the introduction of the elective system has helped the matter. The tendency toward early specialization is constantly increasing, not only in the technical schools, but in the schools of arts and sciences. This tendency makes it more difficult for general information, such as is desirable, to be given to the engineering student, and this condition seems to the author to argue against the union of technical schools, pure and simple, with general universities. It is thought that the tendency of our universities to follow in the wake of the German universities is making them unfit for doing the so-called general culture work, not only for engineering students, but for all students; that the specialists in all lines of work are becoming narrow, and the giving of general culture courses is discouraged. While great specialization is necessary in carrying on work of the highest character, it is not thought that the men who do this are the best suited for imparting general information to the younger men. The courses which they offer are not suitable, and special courses should be provided. It is not necessary for the students in these courses to know the methods of study, but they should know the results of such study. The author also urges that there be included in the general courses some engineering instruction. While it is not possible for us to become a nation of engineers, it is desirable that all educated persons should have some general knowledge of engineering. He can not be a truly educated man who is ignorant of the conditions which surround him, and of the methods by which his daily intellectual and physical needs are met. This training should not be given for the purpose of making half-baked experts, but for teaching the student the importance of solving the problems of manufacture, distribution and transportation. These problems stand for the providing of material and mental food for the masses, the betterment of their conditions of living, for healthier homes, for the intellectual growth which is made possible by freeing man from soul and mind-killing drudgery. Public service is what engineering stands for, and doubtless the cultural effect of such work will be admitted. Moral integrity does not necessarily go with cultural training, so-called. The danger to the community lies not in the character of the work, but in the character of the man; and the nation is in no danger, even if it be largely a nation of engineers, as long as these men are men of character.—*Abstracted from the Popular Science Monthly (Lancaster), September.*

Dissimilar Electrodes, Valve Cells and Metal Vegetation.

Some time ago Herr W. Holtz noticed a peculiar action when electrolyzing a salt with electrodes of unequal size. The smaller electrode became covered with a brown deposit. Upon looking into the literature of the subject, he found that the effect had been noticed previously by various observers, but the matter seemed to be sufficiently interesting to lead him into a very complete investigation. The phenomenon really belongs to the same class to which the aluminum interrupter or rectifier is assigned, and Herr Holtz found that fairly satisfactory rectifiers could be made by using any one of a large number of electrolytes or metals. Some of his experiments are given here. They include cells containing electrolytes of different concentrations of sulphuric acid, and electrodes of platinum. In all of these the direction of current—which in this case was direct—was passed in one direction first and then reversed, and the action of the cell in impeding its flow was observed, as well as the change at the two electrodes. It was found in each case necessary to clean thoroughly the electrodes before proceeding with the experiments, otherwise concordant results could not be obtained; and in any case widely varying values were secured under what appeared to be precisely similar conditions. The latter trouble, it is explained, is due to the very small area of the smaller electrode, where slight changes will produce great differences in the effect. In certain of his experiments, conducted on the same electrodes, but with electrolytes of different concentrations, the valve action changed progressively with the concentration. In others a maximum point seemed to be reached where a further increase in the concentration caused a decrease of the phenomenon. In another case, in which aluminum chloride was the electrolyte, the cell acted as a reversed aluminum cell. The concentration of this solution was ten per cent; at no time was the current entirely interrupted. Cells constructed of copper and copper sulphate, copper chloride and copper nitrate behaved variously. Experiments were also conducted with electrolytes of various organic acids. The researches, while not complete, lead to some interesting generalizations. Half of the metals show this effect when the anode is the smaller electrode; the other half when the cathode is the smaller. Many metals show this effect with certain concentrations or at certain voltages, but not at others. Generally the valve action is the greater the greater the concentration and the lower the potential. Very satisfactory cells of this kind, for low potentials, have been constructed of iron, lead, nickel, antimony and bismuth in a one per cent solution of sulphuric acid. Copper, copper sulphate and copper chloride behave well with average potentials. With some of the metals metal-trees form on the small cathode. Some give a deposit of dust; others a spongy coating. If the action is due to the anode it is thought to be brought about by a coating of some oxide of the metal, if it is due to the cathode it is brought about by a layer of oxygen.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), August* 1.

With a direct current of sixty to seventy volts, by using two parts bauxite and three parts chromite, a fifty per cent ferro-chrome is obtained, which incidentally takes up the silicon from the bauxite. The aluminum produced at the same time is ninety-eight to ninety per cent pure, and is colored rose red by a trace (not over 0.1 per cent) of chromium sesqui-oxide. It can be purified by remelting and keeping it covered with aluminic material.

INDUSTRIAL SECTION.

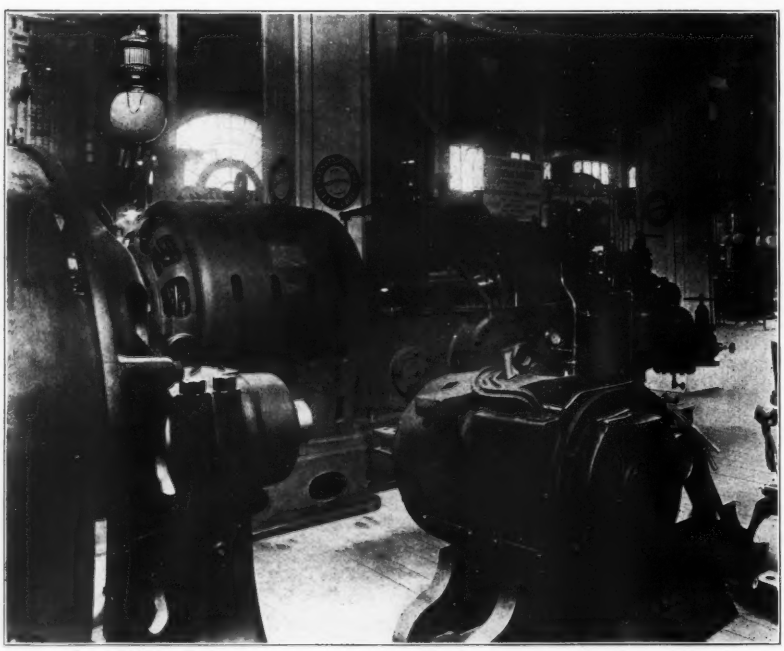
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Westinghouse Electric and Manufacturing Company at the Lewis & Clark Exposition.

The development of apparatus for the generation, distribution, control and application of electrical power has been so rapid that engineers, station managers, power users and the engineering public in general have been compelled to keep constantly in touch with the electrical field in order to remain abreast of the times. The latest and most improved products in every line of industry may always be seen at expositions and fairs, which are great educational factors. At the Lewis and Clark Exposition, Portland, Ore., in the building devoted to machinery, electricity and transportation, the Westinghouse Electric and Manufacturing Company occupies 1,500 square feet of floor space. This section is devoted to the display of many kinds of generators, motors, controllers and instruments of every description.

Starting in at the main entrance to the exhibit attention is attracted by the most prominent and most interesting feature of the display, a 400-kilowatt Westinghouse-Parsons turbo-generator unit. This outfit represents the most efficient and most economical type of apparatus which has ever been produced for transforming the energy of steam into that of the electric current. To the left is a showcase containing all the standard types of portable instruments, and just behind this is an electrically operated distant-control, automatic, oil circuit-breaker, designed to open a 200-ampere, 33,000-volt circuit.

THE WESTINGHOUSE ELECTRICAL EXHIBITS AT THE LEWIS AND CLARK EXPOSITION. ALTERNATING-CURRENT AND DIRECT-CURRENT GENERATORS AND MOTORS IN THE FOREGROUND. 600-HORSE-POWER STEAM TURBINE AT THE LEFT, IN THE REAR.



THE WESTINGHOUSE ELECTRICAL EXHIBITS AT THE LEWIS AND CLARK EXPOSITION. 600-HORSE-POWER STEAM TURBINE UNIT OPENED FOR INSPECTION.

Passing on down the aisle we see a No. 92, fifty-horse-power, direct-current and a No. 107 seventy-five-horse-power alternating-current, single-phase, series-railway motor, and a switch group of the multiple-control system. To the right is a group of type S motors, including a vertical-type machine, a twenty-five-kilowatt rotary converter, and a two-kilowatt type S generator direct-connected to an Ohmen high-speed engine, manufactured by the Ohmen Engine Works, San Francisco, Cal. Across the aisle is a motor-generator set, consisting of a 150-horse-power induction motor and a 100-kilowatt, direct-current, engine-type generator; and in immediate succession are a group of type R direct-current motors, one-sixth to one horse-power, a 120-kilowatt, revolving-field, self-contained, alternating-current generator, and a 100-horse-power type HF induction motor. At the extreme rear the Sanitary Device Manufacturing Company displays in conjunction with this exhibit an automatic dust-removing plant driven by a type S motor.

In the rear section are also some distinctive types of Westinghouse transformers,

including a 110-kilowatt, air-blast transformer, a number of type OD, type N, manhole type, and five OD transformers, ranging from seven and one-half to twenty-five kilowatts, are mounted on the wall. On turning to the left and walking toward the main entrance may be seen a group of induction motors, types H and CCL for constant-speed work, and types F and C for variable-speed service. A line of special motors, both alternating current and direct current, for crane service is also shown. Standard switchboard instruments, comprising voltmeters, wattmeters, ammeters, power-factor meters, etc., are arranged on display boards against the wall. In the controller section are found an oil-immersed autostarter for use with the CCL motors, a rheostatic controller for the type HF motor, an elevator controller used with type F motors, an automatic pump controller and finally a three-wire double-voltage controller for use with direct-current motor in machine-tool drive. Near the centre of the exhibit is a rope hoist manufactured by the Denver Electric Company, to which is connected a No. 103-A type F induction motor. Various classes of fuses artistically arranged on a board, a double-throw oil-switch, a static interrupter, choke coil and lightning arresters complete the display.

The exhibit is illuminated by two large "Westinghouse" display signs, and by series-multiple arc lamps suspended from artistic goose-neck posts. It might be mentioned in this connection that the entire building is lighted by Westinghouse lamps of similar pattern.

An Incandescent Concentric Diffuser.

The incandescent concentric diffuser recently designed by the General Electric Company, Schenectady, N. Y., and illustrated herewith, will prove of great interest to those who have in the past been bothered by the problem of adequate illumination under mezzanine floors, in basements, and similar places, where low studding eliminates the arc lamp, and large area the separate incandescent lamp.

Grouping incandescent or Meridian lamps necessitates for the best results a reflector with the widest possible range of lower hemispherical distribution. This new incandescent concentric diffuser, with its corrugations of progressively increasing amplitude, appears to be exactly what was needed.

The diffuser is twenty-six inches in diameter, and is made of steel, coated with high-grade Austrian air-dried enamel, which does not turn yellow, but becomes whiter with age. The black deposit which usually accumulates on the ceiling above the lamps is received by the diffuser, from which it can be readily washed off, so the diffuser protects the ceiling in addition to giving an excellent distribution of light.

The diffuser can be installed near the ceiling or on any extension rod, and any standard make of cluster with four-inch base can be used. The best effects have been obtained with one twenty-five or fifty-candle-power Meridian lamp in the lower socket, and three, four or five standard frosted eight, sixteen or thirty-two-candle-power incandescent lamps set radially, as shown in the illustration.

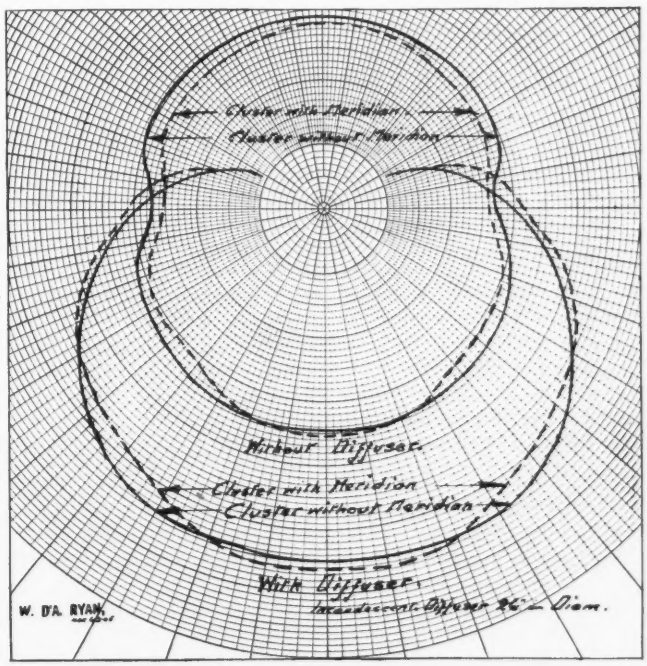
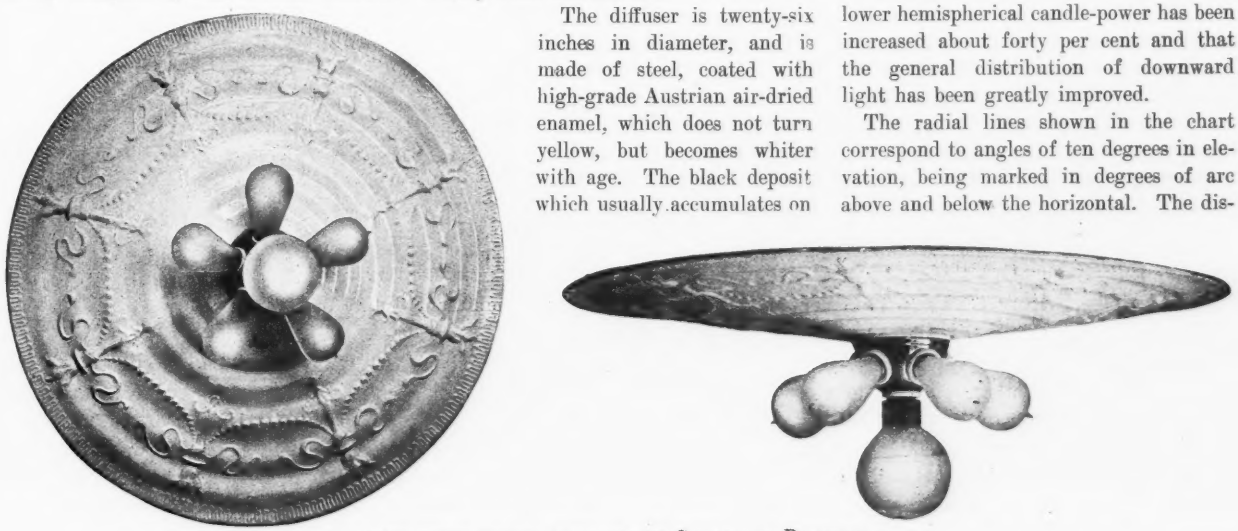


Chart Showing Variation of Luminous Efficiency.

From the chart it will be seen that the lower hemispherical candle-power has been increased about forty per cent and that the general distribution of downward light has been greatly improved.

The radial lines shown in the chart correspond to angles of ten degrees in elevation, being marked in degrees of arc above and below the horizontal. The distance along these lines from the centre to a point on the curve represents the intensity of candle-power in that direc-



Two Views of the Incandescent Concentric Diffuser.

tion. For instance, referring to the solid line curves, we find that at sixty degrees below the horizontal the cluster alone gives eighty-five candle-power. This may be read either at the right or left-hand side of the sheet. When the diffuser is used this is increased to 136 candle-power, showing a gain of sixty per cent in this particular direction. While it is not advantageous to have all the light concentrated directly beneath the lamp, it is obvious that the most useful light is that thrown below the horizontal and that the light thrown above the horizontal can not be utilized except as it is reflected downward from the ceiling.

A Complete Electric Kitchen for the Ontario Power Company.

The Niagara Construction Company, Limited, of Niagara Falls, South Ontario, Canada, has placed with the Prometheus Electric Company, 39 Cortlandt street, New York city, an order for a complete electric kitchen sufficiently large to prepare meals for fifty persons, and which will be used on the occasion of the opening of the new power station of the Ontario Power Company.

The equipment consists of an angle-iron table eighteen feet long, on which are mounted three five-gallon urns with inner vessels for milk, coffee and hot water; one oven capable of taking twenty-five-pound roasts or the equivalent; two large copper vessels for boiled dinners; three twelve-inch by thirteen-inch broilers; one plate-warmer forty-five inches by sixteen inches by thirty inches; and one steam table five feet long by two feet wide, designed to take four food compartments.

The total outfit is designed for a consumption of twenty-seven kilowatts, and the output will be controlled separately by means of switches and keys.

Street Railways in Manila.

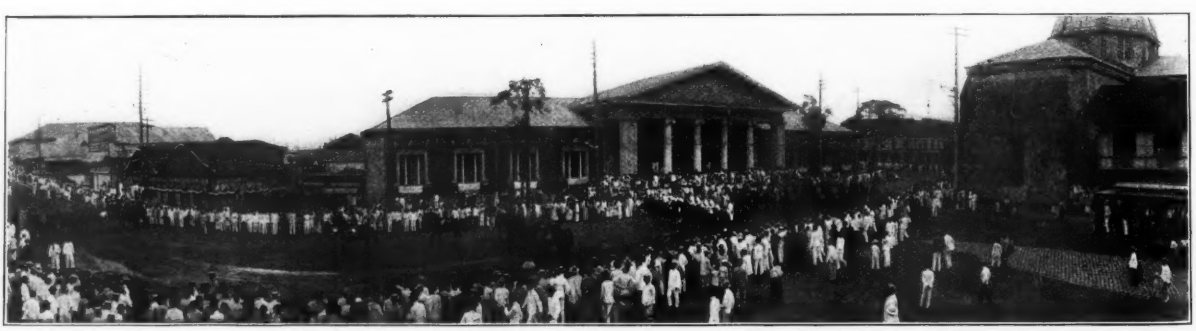
A long step forward in the Americanizing of the Filipino was celebrated recently at the official opening of the Manila street railway. The plant of the Manila Electric Railway and Light Company not only serves the purpose of supplying adequate transportation and lighting service to Manila, but it justifies the belief of the White company's engineers that it was possible to educate the Filipino so that he could undertake skilled work as well as that of an ordinary laborer. It is extremely gratifying to note that many Filipinos are now employed in the capacity of carpenters and machinists, as well as conductors and motormen on the cars.

During the last two and one-half years some 1,500 to 2,000 of the "little brown men" have been occupied in erecting the power-house and car barns and installing a complete electric system. Their wages ranged from fifty to seventy cents per day, varying according to their occupation. The Filipinos were well satisfied with this small sum, because it was almost twice as much as they were accustomed to receive. The main trouble was to keep them at work steadily. With their increased wages they felt that two or three days of consecutive labor was quite sufficient. By allowing them to observe innumerable feast days, and letting them take a rest in the middle of the day when the heat was intense, the foreman found that they were more willing to work.

A hard problem was to find a wood for ties and poles, and also for the car bodies, which would withstand the assault of the white ant and be practically weatherproof. As an experiment, three kinds of wood were used for ties: the native wood called molave, California redwood, and an Australian wood. Further experimenting has been done by treating the ties with preservatives such as creosote, jodelite, solignum and carbolineum. The rails were painted with asphaltum, and in low-lying ground were laid in concrete.

The only wood which seemed to be ant-

ELECTRIC CAR, MANILA, P. I., WITH FILIPINO CONDUCTOR AND MOTORMAN. CAR BARNS IN BACKGROUND, CONSTRUCTED OF STEEL AND CONCRETE TO AVOID DESTRUCTION BY WHITE ANTS.



PARADE, MANILA, P. I., FOURTH OF JULY, 1905. NEW ELECTRIC STREET CAR AT EXTREME RIGHT.

proof was teak, and the cars were built of this material, combined with steel of a heavy design which was carefully protected with rustproof paint. Teak is a dense hard wood which needs no chemical treatment. It is difficult to work with tools and to steam bend, and has such a beautiful appearance that the cars were finished in the natural color wherever possible.

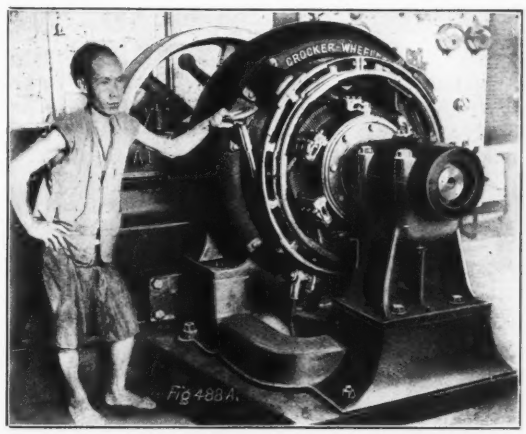
The Manila climate is intensely hot, and hurricanes are a common occurrence. The majority of the equipment consists of open cars, but several convertible and semi-convertible cars are being used for experimental purposes. Absolute simplicity was the keynote of the designs for the cars, so that there would be no difficulty in keeping the cars clean. The heavy, driving storms occur so frequently that extra precautions were taken to secure the comfort of the passengers. All cars are vestibuled and equipped with curtains of Pantasote mounted on extra heavy slats which will resist the strongest wind. The gutters, water ducts, and cables for curtains are made of non-rusting metals, and the dashboards of extra heavy steel. There is a considerable overhang to the monitor roofs, and the ventilation is so arranged as to readily dispose of any water which may collect.

The Manila Electric Railway repair shops are thoroughly equipped to design and build their own cars, and are conducting experiments with a view to using native woods. The present equipment consists of ninety-five passenger cars furnished with Westinghouse two-motor equipments throughout. On account of the lower price of teak wood in Europe most of the car bodies were purchased there, but the trucks were purchased in America. The power-house contains four Westinghouse turbo-generators which produce approximately 4,000-horse-power electricity for general power purposes, and lighting is furnished by the company as well as the power for the street railroad. The power-house, car barns, and other buildings are built entirely of steel and concrete, all metal being painted to guard against deterioration.

Viewed as a whole, or in detail, the plant of the Manila company, which was built and is being operated by J. G. White & Company, of New York, is fully up to the most advanced standard of American practice, and it is a matter of no small importance that the Filipinos should have in their capital city such an object lesson and training school in up-to-date mechanical engineering.

American Dynamos in an Oriental Printing House.

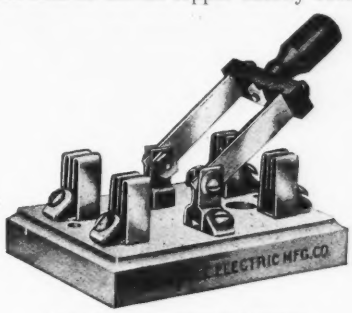
The accompanying illustration shows a photograph taken in the power plant of the Bureau of Public Printing at Manila, Philippine Islands. This photograph was made by Mr. Earle L. Tatum, electrical engineer in charge. The plant includes two standard fifty-kilowatt Crocker-Wheeler generators. One was installed last year, and the other in 1901. It is significant of the simple design of these machines that, after being shipped halfway around the world, they may be operated by the natives, whose mechanical experience seldom comprehends anything more intricate than a wooden plow. The native shown in the picture is quoted by Mr. Tatum as saying: "Me sabe Crockerne-Whelem electricidad maquina," which, roughly translated, means "there is nothing I don't know about Crocker-Wheeler machines."



CROCKER-WHEELER DYNAMO AND NATIVE ATTENDANT, BUREAU OF PUBLIC PRINTING, MANILA, P. I.

The Trumbull All-Copper Battery Switch.

The accompanying illustration gives a good idea of the all-copper battery switch made by the Trumbull Electric Manufacturing Company, Plainville, Ct. In this new switch the weak points prevalent in baby knife-switches have been eliminated. The front clips are self-adjusting, ensuring good contact. The binding contacts project from the base, making it easy to fasten the wires, which enter from the back through holes left for this purpose. The handle is strengthened by having the fastening screw extend nearly the entire length, and ensures its not breaking under any strain received in ordinary use.



ALL-COPPER BATTERY SWITCH.

The Trumbull company has moved into its new factory at Plainville, where, with increased facilities, it will be able to turn out its specialties in quantities to satisfy any demand.

An Electric Car Brake.

For some time there has been in operation on a car of the Toronto Suburban Railway a new electric brake patented by George C. Royce, and which is the subject of Canadian patent No. 94,152. The brake consists of a small double-wound motor, to which a chain-winding shaft is geared, having a dog wheel and brake wheel attached to its armature shaft, and a separate small controller and regulator. The brake occupies a very small amount of space, and can be installed under the platform of any double-truck or single-truck car.

The current required to operate the brake is drawn from a trolley line, but should the trolley pole accidentally leave the wire or the power go off the current is then drawn from the car motors acting as generators to apply the brake. In either case only an impulse of current is required to make the application. The current is not needed to hold the brake on, as the dog wheel and brake wheel on the armature shaft of the brake do this; hence the consumption of current is very small.

There are only two notches on the brake controller, and an effective braking is secured no matter which of the two notches is used. In case of an accident, the trolley pole coming off, the power going off, or the brake shoes suddenly becoming inoperative by the brake chain breaking, the motorman has still the use of a powerful braking system by turning the brake controller handle to the second notch and using the car motors as generators to apply the brake.

When the car is stopped, on whatever grade, it is held until released by the mechanical dog wheel and brake wheel attachment. A switch is connected with the brake, by which the motorman can adjust the shoe pressure to suit the changing condition of the rails, reducing the chances of the car skidding.

Suction Gas Producers.

Suction gas producer plants are being successfully introduced in this country on account of their simple working and great economy in running and maintaining expenses. They are used in connection with a gas engine for developing power for all kinds of industries and shops.

A suction gas producer is working successfully in the machine shop of F. W. Horstmann Company, East Newark, N. J. This shop which was using illuminating gas, in connection with a gas engine, is using now a gas producer. The plant which was built by Dr. Oskar Nagel, of New York city, is working according to the guarantee given with the plant, that is, the development of one brake-horse-power-hour from one and one-quarter pounds of anthracite (pea) on full load, one and one-third pounds on three-quarter load, and one and one-half pounds on half load.

The plant has a capacity of twenty horse-power and consists of a hand-blower, producer with evaporator on top of same and a scrubber which is shown. The overflow water-pot, which belongs to the plant, is in the pit between the producer and the scrubber, and a small equalizing tank is connected on the floor below to the engine so as to connect the scrubber with the engine.

By the sucking action of the engine the air is drawn over the surface of hot water in a water-jacket and saturated with steam, and this saturated mixture of steam and air is drawn through the fuel whereby the producer gas is generated. From the producer the gas goes through the scrubber which is filled with coke, and where it is freed from dust and tar by means of water. From the scrubber the gas goes through the equalizer, which is a simple iron drum, to the engine.

This plant is provided with a hopper which is sufficiently large so as to contain fuel for the whole working-day, so that no refilling of coal is required during the working-hours. After shutting down over night the lower door is kept somewhat open and also the valve leading to the flue so as to keep up a little draft and maintain the fire. In the morning before starting up, the fire is cleaned from the ashes and the hopper is filled with coal, and then the fire is blown hot for about ten to fifteen minutes by means of a hand-blower until the gas is burning well at the test cock, and then the engine is started as usual.

During the working-day the plant does not require any attention except cleaning the grate once or twice a day.

Flexible Steel-Armored Hose.

The extreme heat generated by steam under pressure causes the inner tube of steam hose to lose its elasticity because of the rubber becoming over-vulcanized or burned. This is particularly the case if the inner hose is subjected to a higher steam pressure than is employed in vulcanizing. The steam creates considerable expansion, and when the pressure is released, the inner tube of the steam hose loses its life and elastic qualities, and breaks up. As soon as the steam is turned on again it enters the interior of the hose through these breaks, and tears the rubber away from the cloth insertions. The rubber then disintegrates, eventually getting into the steam chest of the drill, causing, in some cases, damage and loss of time. The tearing away of the inner tube leaves the cloth insertion bare, and in a short time the hose will become useless, as the steam will blow such a hose with a damaged inner tube to pieces.

With the new type of hose known as flexible steel-armored hose the nature of the armor prevents expansion, and the armor strips are so tightly interlocked that it is impossible for the steam to blow the hose apart. Steam hose, in being dragged around rocks and other obstructions, is liable to kink. This kinking will in a short time break the hose from the outside. The hose then becomes unable to stand the necessary pressure, and bursts. With the flexible steel-armored hose this kinking is overcome, as the nature of the armor maintains a uniform internal diameter and makes it impossible for the hose to kink in the armor.

Flexible steel-armored hose is remarkable for its durability, the armor eliminating the destructive strain of expansion, protecting the rubber lining from external injury, and making it a proposition that may be relied upon in emergency. If it should so happen that the inner rubber hose becomes damaged, the flexible steel armor prevents an open rupture, with the result that sufficient steam pressure is maintained to continue the use of the hose. A drill or other machine can thus be used with a damaged hose until it is convenient to replace it with another piece.

The Sprague Electric Company, 527 West Thirty-fourth street, New York city, is the manufacturer of this hose.

The Pusey Regulator.

The Pusey voltage regulator, manufactured by the Pusey Voltage Regulator Company, 618 Fidelity Building, Philadelphia, Pa., is practically composed of three working parts—the beam, controlled by the solenoid for making electrical contact; the reversible motor, for working the gear; and the clutch, to be attached to the rheostat and connected to the motor by means of a chain of gears.

The beam is operated by a solenoid which makes an immersion contact. One contact is placed at each end of the beam. Each of the immersion contacts is connected to one or the other side of the reversible motor. These contacts are sparkless, enabling them to last indefinitely.

In series with the beam and motor is an electrical contact composed of a platinum pointed thumb-screw and spring placed on the solenoid and under the side of the beam, which makes a downward plunge when the solenoid is deenergized. The purpose of this is to break the direct current through the beam so that there is no current through the beam except when the solenoid is energized. This is to prevent the motor from running in case the circuit through the working solenoid should become broken.

There is a small rheostat placed in series with the working solenoid, the purpose of which is to adjust or set the solenoid to operate on different voltages. The direct current flowing through the beam is for the purpose of running a reversible motor and passes through a contact which is placed upon the solenoid. The machine is sensitive to one-quarter of one per cent and may be regulated by raising or lowering the immersion contacts.

The regulator is mounted on a marble slab in sizes to fit the switchboard panels. If this construction is not desired, the apparatus can be made as an independent board as shown in the accompanying illustration.

A "Show" Plant for Newark, N. J.

Mr. S. H. M. Agens, of the Electric Motor and Equipment Company, Newark, N. J., has bought for the Newark arcade now being erected in that city for Colonel Frederick G. Agens, two fifty and one twenty-five-kilowatt General Electric generators, to be direct-connected to two eighty-horse-power and one forty-horse-power Armington & Sims automatic high-speed engines. The boilers are being made by Theo. Smith & Sons Company, Jersey City. The wiring will be done by the Beaver Construction Company, of Newark. It is Mr. Agens's intention to use throughout, for store and corridor lighting, the new high-economy Edison lamps, with the Holophane reflectors. It will be a "show" plant in which there will be more than local interest.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TOLEDO LIGHT COMPANIES MERGER—Articles of consolidation have been issued for the Toledo Electric and Heating Company, a combination of the Toledo Gas Light and Coke Company, the Citizens' Light Company, and the Toledo Heating and Lighting Company. The consolidated company is capitalized at $2,500,000.

EXTENSIVE DAM TO BE BUILT ACROSS THE SUSQUEHANNA RIVER—A large dam will be built across the Susquehanna river, about twelve miles from York, Pa., costing about $2,500,000. It is expected that the dam will be finished in two or three years, and it is announced that one of the largest power plants in the world will be built at this site. Harvey Fisk & Sons, of New York, are said to be the managers of the syndicate, which is underwriting $10,000,000 of bonds for the carrying out of the work.

POWER PLANT ON PINE RIVER, MICH.—A plan is under way to establish a power plant in the Menominee iron range at Pine River Falls, eight miles from Florence, Wis. It is estimated that 12,000 horse-power can be developed. It is said that this power will be used to supply Florence, Wis., and Crystal Falls and other Michigan towns. It will also supply current for an interurban line running from Iron Mountain through Florence County to Crystal Falls. A. E. Edmonds, of Rhinelander, is said to be at the head of the project.

EXTENSIVE TRACTION DEAL—It is announced that four Boston-controlled traction properties in Indiana and Ohio have been sold to the United Gas Improvement Company, of Philadelphia, Pa. The properties involved are the Indianapolis & Western Traction Company; the Columbus, Buckeye, Lake & Newark; the Indianapolis & Northwestern, and the Columbus, Newark & Zanesville, all built and managed by Tucker, Anthony & Company. It is understood that the sale involved the transfer of about $14,000,000 in cash and securities.

STREET RAILWAY CORPORATION MERGER—It is understood that plans are under way to effect a combination of electric street railway and gas plants in western Pennsylvania and eastern Ohio. The consolidation will control something like thirty corporations, including 175 miles of street railways, and will have a capital stock of $10,000,000. The name of the new company will be the Mahoning & Shenango Railway and Light Company. The railways touch Youngstown, Sharon, Levittsburg, Warren, Niles, New Castle, Girard, Strothers, Lowellsville and Wampum, and the consolidation will include the lighting plants of the cities. It is announced that August Belmont, Myron T. Herrick, Murray Verner and James Parmelee are interested in the combination.

THE ATLANTIC TELEPHONE COMPANY—The Atlantic Telephone Company, the new independent telephone corporation which is trying to secure a franchise to operate in New York city, has filed plans and will present its case before the board of estimate at its meeting on September 15. The number of exchanges proposed for Manhattan is eighteen; for Brooklyn, fourteen; for Queens, nine; for Richmond, four, and for The Bronx, six. Wherever possible the wires of the company will be laid underground. The number of miles of wire in the different boroughs will be as follows: Manhattan, 30,000 miles; Brooklyn, 15,000 miles; Bronx, 7,500 miles; Queens, 2,000 miles; Richmond, 1,500 miles. The officials of the company estimate the number of telephones that will be in operation in the different boroughs after the company has been in operation five years as follows: Manhattan, 55,000; Brooklyn, 30,000; Bronx, 15,000; Queens, 5,000; Richmond, 1,000.

MEXICAN ELECTRICAL NOTES—Canadian and American capitalists are interested in a new railway in Mexico, to be called the Morelia & Tacambaro Railway, the capital of which will be $11,000,000. The directors are J. L. Greatsinger, Brooklyn; A. J. Peyton and C. D. Knapp, Jr., New York; C. C. Frick, H. H. Shindel and Henry H. Weber, York, Pa.; C. M. Heat, Trenton, N. J.; D. S. Cook, Wrightsville, Pa.; E. J. Chamberlain and G. E. Fauquier, Ottawa Canada. E. J. Chamberlain is president; G. E. Fauquier, vice-president and general manager; J. L. Greatsinger, second vice-president, and C. D. Knapp, Jr., secretary. The total length of the line is to be 225 miles. It is planned to complete it in eighteen months. The new line will run north and south from Irapuato, in the state of Guanajuato, to Tacambaro, in the state of Michoacan. A concession has been granted to the Mexico Electric Tramways, Limited, for the construction of new lines in the Santa Maria quarter of Mexico City. The period of the concession is until February 4, 1982. The construction of the first circuit must be completed within three years from the date of the issue of the contract.

NEW PUBLICATIONS.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS—The proceeding of the annual meeting of the Association of Railway Telegraph Superintendents, held at Chattanooga, Tenn., May 17 and 18, 1905, has been published. In addition to the convention data there are a copy of the constitution and by-laws and a list of members.

REPORT OF PUBLIC LECTURES, DEPARTMENT OF EDUCATION—The Department of Education of the city of New York has published a report of the public lectures given during the season 1904-1905. The report is compiled by Henry M. Leipziger, Ph. D., and contains a list of the subjects and lecturers, with a commentary upon the scope and value of the work. A summary shows an attendance at the free lectures as follows: borough of Manhattan, 490,572; borough of The Bronx, 171,498; borough of Brooklyn, 327,063; borough of Queens, 124,513; borough of Richmond, 40,345; a total attendance, at 4,645 lectures, of 1,153,991.

THE MICHIGAN CENTRAL (the Niagara Falls route) has published a handsome folder containing time-tables and data concerning all of its connecting lines. This folder also announces No. 8 "The Wolverine," a new fast train from Chicago to Detroit and Michigan points; the equipment consists of buffet library car, parlor car, smoking car and first-class coaches. From Grand Rapids, Bay City, Saginaw and Detroit this train will carry high-class sleeping cars to New York. C. F. Daly, Chicago, Ill., is passenger and traffic manager; O. W. Ruggles, Chicago, Ill., is general passenger and ticket agent, and J. W. Daly, Buffalo, N. Y., is chief assistant general passenger agent.

THE POWER OF AN IDEAL—The Moody Corporation, New York city, has published a most interesting brochure, entitled "The Power of an Ideal," describing the development of its work in dispensing financial statistics. The Moody Corporation began business in the spring of 1900, under very inauspicious circumstances. In the fall of that year the first issue of "Moody's Mannual" appeared. This publication won instant success, and to-day is considered one of the most valuable of books of reference. The company has added other annuals to its list of publications, and has now under its control an important publishing business requiring the facilities of a large plant and a host of skilled employés.

EDUCATIONAL.

OHIO STATE UNIVERSITY—The Ohio State University, Columbus, Ohio, has issued an announcement of courses offered in the college of engineering for 1905-1906. These include architecture, ceramics and chemical, civil, electrical, mechanical and mining engineering. In addition courses are offered in industrial arts and manual training. The entrance examinations will be held September 12, 13, 14 and 15. The fall term opens September 18.

TELEPHONE AND TELEGRAPH.

TOLEDO, OHIO—The Toledo Home Telephone Company is preparing to erect a new three-story building.

CUERO, TEX.—The Southwestern Telephone Company has a force of men at work remodeling its exchange.

UTICA, N. Y.—The Central New York Telephone and Telegraph Company will build a telephone line to Frankfort Hill.

HEPBURN, PA.—The Ralston Telephone and Telegraph Company expects to extend its lines to Hepburn in the near future.

WATERTOWN, S. D.—A franchise has been granted to the Western Union Telegraph Company to operate messenger service boxes within the city limits of Watertown.

TONAWANDA, N. Y.—The Bell Telephone Company has been granted permission to string a series of six cables into the town and install a new central energy system.

PARSONS, KAN.—The Parsons city council has granted a franchise to the Missouri & Kansas Telephone Company, allowing the company to do business in the corporation limits for twenty years.

LANCASTER, N. Y.—The Frontier Telephone Company has applied to the Lancaster village board for a franchise. Lancaster is the only village in the county without a competing telephone company.

KINGSTON, N. Y.—Officers have been elected by the Citizens' Standard Telephone Company, as follows: Mortimer C. Drake, president; Thomas M. Brush, vice-president; Charles Reynolds, secretary and treasurer.

ATLANTIC CITY, N. J.—The service of the Western Union Telegraph Company between Atlantic City, New York and Philadelphia has been increased by five new copper wires, which lead into the local office. Three of the new wires go to Philadelphia, and two go to New York.

MARION, IND.—It is announced that the Converse Telephone Company has been merged with larger interests, and that the new company will enter the Marion field. O. L. Barger, who has owned the Converse company, has transferred his stock into the new company and will continue actively with the organization.

DALLAS, TEX.—The business men of Dallas, Tex., have organized the Texas Consolidated Long-Distance Telephone Company which is now putting in the city 200 long-distance toll stations, and building toll lines westward. It is stated that its toll charges will be thirty per cent less than those now charged.

FREDERICKSBURG, VA.—At the annual meeting of the Toluca & Fredericksburg Telephone Company, held at Stafford courthouse, the following officers were elected: Hugh Adie, president; C. A. Bryan, secretary; E. S. Moore, business manager; directors, N. B. Musselman, R. A. Moncure, T. J. Waller, C. A. Bryan, M. K. Lowry and T. A. Groves.

CORONA, CAL.—The council has decided to advertise a franchise requested by the Corona Home Telephone and Telegraph Company. The franchise provides for poles in the alleys, instead of in the streets. It is proposed by the corporation to install a modern system and to give a continuous service day and night, including Sundays.

READING, PA.—The Conestoga Telephone Company has secured permission from the Baumstown Foot Path Association to erect telephone poles along the path from the Pennsylvania & Reading station to Baumstown. The company will take this route for an extension of its lines to the farmers of Exeter and all through the section adjacent to Baumstown.

SIOUX FALLS, S. D.—The business men of Plankinton have organized a stock company, as the result of which that place may have a second telephone system. The present system, which is owned by J. D. Bartow, a citizen of the town, will be purchased if the price can be agreed upon. Otherwise the stock company will establish the second system.

NEW YORK, N. Y.—Plans have been filed with Building Superintendent Reville for a new three-story telephone exchange building, to be erected for the New York Telephone Company, on Webster avenue, in The Bronx. It is to be of brick, with trimmings of ornamental stone, and will have a frontage of fifty-two feet and a depth of ninety feet. The cost will be $75,000.

FULTON, N. Y.—The Fulton common council has granted the Empire State Telephone and Telegraph Company permission to place its wires in electrical subways. The company was also authorized to construct, maintain and operate lines of telephone wires upon, over and underneath the surface of the streets, avenues, alleys and public places of the city of Fulton.

MOBILE, ALA.—At a meeting of the Home Telephone Company the following officers and directors were elected for the ensuing year: W. C. Polk, president; W. H. Bryant, vice-president and general manager; R. L. Douglas, secretary; A. Proskauer, treasurer. The last three were reelected. Directors: W. C. Polk, W. H. Bryant, P. J. Lyons, J. C. Monteith and Adam Glass.

SPRINGFIELD, ILL.—The Central Union Telephone Company proposes to spend a quarter of a million dollars in Springfield this year in the matter of improvements, including underground wires in the business district and the erection and equipment of one of the most up-to-date telephone plants in the country. The work on the underground equipment will commence at once, as will also the erection of the building. The latter is to be ready for occupancy by December 1.

WILMINGTON, DEL.—By order of the court the Bucks County Trust Company, trustee under the mortgage, sold to R. D. Brown all the property and franchises of the Standard Telephone and Telegraph Company. The price paid was $50,000. This company, which went into the hands of a receiver a few months ago, has been operating less than four years. Due to competition and inadequate rates the company was not able to meet its current operating expenses or to lay aside a fund to offset the depreciation of its plant.

COOPERSBURG, PA.—The Coopersburg Rural Telephone Company has started work on its lines to be erected in Coopersburg. The holes have all been dug, and the poles will be set up at once. This company is composed of ten business men, who will erect the line and enjoy free service among themselves. All lines will be connected with the Bethlehem exchange of the Bell company. Each subscriber will have the privilege of long-distance service at the regular rates. When the line is completed other parties will be invited to connect at a low yearly rental.

WHITE PLAINS, N. Y.—Plans have been completed by the State Line Telephone Company for the building of a line to connect all the towns and villages in Westchester County. In Brewster connection will be made with the Putnam County system, which has been in course of installation for the past year, and by this means with thousands of independent telephones throughout the state. This will give the State Line telephone subscribers connection with Putnam County through to Newburgh, Poughkeepsie, Hudson, Albany and west to Buffalo, where connection can be made with independent companies throughout the West.

NEW MANUFACTURING COMPANIES.

DENVER, COL.—The Miller-Hoppin Electric Company has been incorporated by John Burton Hopkins, Frank F. Miller and James E. Bowden. The capital stock is $10,000.

HARTFORD, CT.—The Rogers Telephone and Electrical Company, of Danbury, has filed a certificate of incorporation. It has a capital stock of $25,000, and it is organized to manufacture and deal in telephones, switches, batteries, motors, dynamos and allied articles. The incorporators are N. Burton Rogers and George L. Eastman, of Orange, N. J.; C. B. Rogers, and A. P. Davenport, of Danbury, and Frank E. Misks, of New York.

ELECTRIC LIGHTING.

SILVERTON, COL.—The Rockwood Power Company has begun the work of extending its lines to Red Mountain.

ROSE CITY, MICH.—James Monaghan and Frank G. Bell have been granted a franchise by the city council to operate a commercial electric lighting plant, and will install it at once.

BLOOMINGTON, ILL.—A syndicate of Detroit capitalists, headed by Emanuel T. Beyer, has purchased the Union Gas Light and Electric Company for $400,000, the amount of the capital stock.

UNION, ORE.—The Grande Ronde Electric Company has placed the order for the necessary equipment to furnish light and power to Union. Work will begin at once, and the system will be completed within the next ninety days.

VINCENNES, IND.—A large addition will soon be made to the power plant of the City Electric Lighting Company. The contract for the erection of the building has been let to A. Combs & Company, which will begin work at once.

HELENA, MONT.—M. H. Gerry, Jr., general manager of the Missouri River Power Company, announces that the Light and Traction Company's property in Helena had been sold to J. G. White & Company, of New York, for $500,000.

KALAMAZOO, MICH.—The Commonwealth Power Company is about to develop a water power to drive electrical machinery, at Ceresco, five miles west of Marshall. The Ceresco water power is on the Kalamazoo river, and it is expected that about ninety horsepower can be developed.

BALTIMORE, MD.—The Hennebique Construction Company has secured the contract for the erection of the power-house to be built for the Consolidated Gas and Electric Light Company at Westport. The structure will be of concrete construction and will represent an expenditure of about $150,000.

SUMAS, WASH.—Sumas will be lighted by electricity within sixty days. The dynamo for the plant has been purchased, and the poles and wire will be erected at once. Power will be secured at the Balcom-Vanderhoof shingle mill. A new automatic engine has recently been installed in the mill for that purpose.

CONCORD, N. C.—The city is to have practically a new electric light plant. Contracts for the necessary material have been let, and bids for the machinery will soon be asked. The plan is to light the city with sixty arc lights, the small incandescent burners now used in places to give way to a well-arranged system of arc lights distributed so as to light the entire city.

DUNDEE, ILL.—The Dundee council has voted to instruct the traction company to install twenty-one new arc lights in locations to be designated by the aldermen. Two hundred and forty-seven lamps are operated now at the rate of $58 per year. According to the terms of the contract the rate shall be reduced to $48 on all above 247, so that the new ones will cost the city $10 less each.

GRAND RAPIDS, MICH.—The M. B. Wheeler Electric Company has been awarded the contract for installing a lighting plant at Rose City, Mich. It will provide for 500 incandescent lamps for both street and residence lighting, the plant being a private enterprise and controlled by Bell and Monaghan. Work begins at once and the station will be in service in thirty days. The cost will be $2,500.

GREENSBORO, N. C.—The Greensboro Boiler and Machine Company has sold to the Greensboro Electric Company four 300-horsepower water-tube boilers and a self-supporting steel stack 125 feet high and eighty-four inches in diameter. The addition of these boilers will double the capacity of the electric company, which was recently granted permission by the secretary of state to double its capital stock.

KANSAS CITY, MO.—The board of public works has approved the plans for the underground heat and power distributing plant, which officials of the Kansas City Electric Light Company propose to build under a franchise recently granted by the council. Charles N. Black, one of the grantees, filed the preliminary plans with the board. These plans call for the expenditure of about $94,000, exclusive of excavation work, in the district bounded by Wyandotte street, Grand avenue, Sixth and Thirteenth streets. Mr. Black explained that this was all the pipe the company expected to construct this fall. Special inspection will be provided for while the work is being done, so that the conduits will not interfere with city work under the streets. Bernard Corrigan, C. N. Black and R. E. Richardson have filed their acceptance of the franchise. They also filed bond in the sum of $25,000.

SOMERSET, OHIO—At a meeting of the city council W. Godfrey Hunter purchased from the city of Somerset the electric light plant at the cost of $10,000, and bought the franchise for maintaining and operating the waterworks and light plant in the city for twenty years. These two franchises, combined with the street railway franchise, which was purchased several months ago by the same party, involve an investment of $250,000.

GRAND JUNCTION, COL.—The city council has refused the Grand Junction Electric and Gas Company the twenty-five-year franchise asked for. The franchise has been before the council for three months, and during that time it caused much comment. The council made the light company a proposition which placed the maximum rate for consumers at twelve and one-half cents per kilowatt-hour and $80 per arc light per annum for city use.

YORK, PA.—The York Haven Electric Transmission Company, which is a subsidiary company of the York Haven Water and Power Company, has begun the laying of a submarine cable across the Susquehanna river from Cly, at the head of the York Haven falls, to Falmouth, on the Lancaster County side. The laying of this cable in the river will be completed within ninety days, and power will be transmitted from the power plant at York Haven under the river to Middletown.

NASHVILLE, TENN.—Charles H. Fisk, of Detroit, Mich., promoter of the Great Falls Power Company, which proposes to utilize the power of the falls of Caney, has paid $30,000, the balance due the Great Falls Cotton Company by virtue of the purchase of the Great Falls property, and will now begin the work of development, which will be pushed rapidly. It is the purpose of the company to manufacture electrical power to be transmitted to Nashville and other cities for the operation of street cars and manufacturing plants.

HELENA, MONT.—Another new electric lighting plant for Cache County, which will operate in Cache County and Oneida County, Ida., will shortly be built. The plant, it is said, will be constructed in a short time and will furnish a large amount of energy. The company will be known as the High Creek Electric Light and Power Company, of Richmond. It is capitalized for $75,000, with shares of a par value of $10 each. The officers are: C. R. Slusser, president; Joseph Monson, vice-president; J. J. Shepard, secretary, and D. C. Budge, treasurer.

LEOMINSTER, MASS.—The formal transfer of stock of the Leominster Electric Light and Power Company to the Boston Heat, Light and Power Company has been made and all the stock that remains in the hands of the former owners is a small block in the possession of E. F. Blodgett. The name of the company will remain the same. Extensive alterations and improvements are being considered by the new company to give better service than in the past, and a large sum will be expended to bring the plant and working force up to a high state of efficiency.

RIDGEFIELD, CT.—A meeting of the stockholders of the Ridgefield Electric Company was recently held, at which the following directors were elected: Henry B. Anderson, John A. Mitchell, George Pratt Ingersoll, George G. Haven, Jr., R. W. Lowe, Albert H. Wiggin and H. P. Bissell. The directors met and elected the following officers: president, Henry B. Anderson; vice-president, George Pratt Ingersoll; treasurer, Albert H. Wiggin; secretary, H. P. Bissell. An executive committee, consisting of President Anderson, Dr. Lowe and Mr. Ingersoll, was appointed.

PEMBROKE, ONTARIO—A deal has been closed by A. A. Rosseau, of Black River, and A. Millar, G. Schmidt, A. Foster, Sr., and J. A. Thibodeau, by which the latter have secured from Mr. Rosseau, the water power owned by him on the Black river near Waltham, Quebec, the present terminus of the Pontiac division of the Canadian Pacific Railway. The price paid is said to be in the neighborhood of $10,000. The new company, which is to be known as the Pembroke Electric Light and Power Company, will absorb the old Pembroke Electric Light Company, and will be prepared before long to provide electric power as well as additional electric lighting for the town.

ELECTRIC RAILWAYS.

ELIZABETH, N. J.—The Public Service Corporation is to establish in Elizabeth a repair shop and construction yards at a cost of $10,000.

HARTFORD, CT.—The Cheshire-Milldale line has been opened. By this link it will be possible for Waterbury people to make an all-trolley trip to Meriden.

EASTON, PA.—The common council has granted an extension of time until December 1, 1905, for the Delaware Street Railway Company to have its road completed within the city limits.

BLUFFTON, IND.—The Fort Wayne, Bluffton & Marion traction line, which is being built by the Union Traction Company, has been granted a franchise by the city council to use Main and Market streets, cars to be running January 1.

HARRISBURG, PA.—The Central Pennsylvania Traction Company has put a large force of workingmen on the Hummelstown extension, and expects to have the line completed connecting Harrisburg with Hummelstown by trolley November 15.

LEICESTER, MASS.—The selectmen of Leicester have granted an extension of franchise to the representatives of the Worcester & Hartford Street Railway Company until November 1, 1906. By this date, say the representatives of the road, the road will be built and in running order.

BUCYRUS, OHIO—The survey of the Columbus, Marion & Bucyrus Electric Railway has been commenced. The line will be an extension of the Columbus, Delaware & Marion now in operation, and will ultimately extend to Toledo and get into Cleveland over other lines. The road has been financed.

ST. LOUIS, MO.—E. W. Hartmann, president of the Ozark Mountain Electric Railroad Company, which was chartered at Springfield, Ill., recently with a capital of $100,000, states that the company has secured the right of way for its line from Freeberg to Belleville and from Belleville to East St. Louis *via* Centreville station.

TRENTON, N. J.—Karl G. Roebling has been elected president and Louis C. Taylor secretary and treasurer of the new Trenton, Hamilton & Ewing Trolley Company. The board of directors of the company is composed of Mr. Roebling and Mr. Taylor, together with William Anderson, B. C. Kuser and Duncan Anderson, who are incorporators.

CLEVELAND, OHIO—A syndicate, composed of J. R. Nutt, George Stanley and William Christy, of Cleveland, has been formed to promote and build a traction line from Youngstown, Ohio, to East Liverpool, Ohio, a distance of fifty-seven miles. It is understood the company plans to carry light freight in addition to the passenger traffic. Work of construction is expected to be under way by November 1.

HUTCHINSON, KAN.—Howard S. Lewis has completed a deal whereby he acquires the L. A. Bigger interests in the Hutchinson Street Railway Company. The purchase was made for a syndicate, of which Mr. Lewis is the head, and which has for its object the transforming of the system into an electric railway system. The organization of the company and the securing of all necessary concessions will be carried out at once.

MAHANOY CITY, PA.—The Pottsville Union Traction Company has arranged to at once start building the long-contemplated trolley line between Frackville and St. Clair. All of the material has been purchased and the work started. It is expected that a franchise through the St. Clair borough will be shortly granted. The new road will be about six miles in length. Superintendent Duncan says it may be completed before cold weather.

DAVIS, I. T.—The citizens of Davis have completed the fund of $12,500 to be donated to the electric railway to be built from Oklahoma City to Sulphur *via* Paul's valley and Davis. According to agreement the work must be commenced between Davis and Sulphur no later than September 8, and completed March 1, 1906. The bonus raised under the contract provides that the entire line of road must be completed not later than August 1, 1907.

SHELBYVILLE, KY.—An eastern syndicate has signed an underwriting contract for the $1,000,000 bond issue of the Shelbyville & Ohio River Electric Railroad Company. Work will begin not later than October 1. The road will open up a fine section of Kentucky to the river. The scheme was promoted by Luther H. Leber, of New York. The right of way has been secured from Milton through Carrollton, over the Carrollton and Prestonville bridge, on to Eminence.

SULPHUR, I. T.—A contract has been signed for the Sulphur electric line to Oklahoma City. The contract states that work will begin not later than September 8, and that cars will be running not later than March, 1906. The contract states that the road shall come *via* Wynnewood, thence to Davis and then across to Sulphur, entering the town east of Tenth street. The depot and switch yards are to be located near the Frisco depot. This road has been talked of for nearly a year.

TELLURIDE, COL.—At a meeting of the city council a franchise was granted F. H. Blair for the construction and operation of a street railway system through the principal streets of Telluride. It is the intention to construct the line from Telluride to all the big mines in Telluride County, and a franchise for this purpose will be asked of the county commissioners. Work on the construction of the lines will begin September 1 and it is expected that the lines will be in operation by January 1.

HAMILTON, OHIO—The Cincinnati Northern Traction Company has announced the location of its $700,000 power-house, which will provide the electrical energy for running cars from College Hill to Dayton, Ohio. The plant will be erected in Lindenwald. It will have a capacity of 7,500 horse-power and generate sufficient power to operate the entire system of the Cincinnati Northern Traction Company. Plans are now being prepared, and construction work will commence in the next thirty days.

BERWICK, PA.—Work on the construction of the Sunbury & Northumberland trolley line will be started at once. This was decided upon at a meeting of the directors of the Northumberland County Railway and Light Company, the new owners of the Edison Electric Light Company in Sunbury. Directors present were: J. C. Pacher, Esq., the Hon. S. P. Wolverton, Esq., Sunbury; George Parkman, W. W. Hepburn, Philadelphia; D. A. Howe, P. B. Shaw, Williamsport; President C. J. Callahan, Sunbury.

DANSVILLE, N. Y.—The contract between the Rochester & Eastern Construction Company and the citizens of Dansville has been signed. The contract states that in consideration of the subscription of $15,000 worth of stock in the corporation by citizens of Dansville the company, which is to build an electric railroad between Rochester and Elmira, will locate in this village its power plant, repair shops and car barns, and probably this will necessitate the location here of some of the officers. The money has all been subscribed.

PITTSBURG, PA.—An electric railway from Wilmore to Gallitzin, Pa., will be built by Pittsburg capitalists. The right of way has been secured, and everything is ready to start operations when the charter is granted. The line taps a rich country and will connect Portage, Cassandra, Bens Creek, Lilly, Cresson, Wilmore and Gallitzin. J. Carroll Barr is one of the interested parties. He says that the road will be operated independently of any of the electric lines of that section. The road will be fifteen miles long and run through extensive coal lands.

SHAWNEE, OKLA.—The city council has adopted an ordinance granting to William E. Fertig and his associates, all of Pennsylvania, a franchise to maintain and operate a street railway in Shawnee for a period of twenty-five years. The new company will purchase the electric light and street railway system of the Shawnee Light and Power and the Shawnee Traction companies by foreclosure sale, and $200,000 will be expended in adding new machinery, purchasing new cars, rebuilding and double-tracking the street railway, putting in extensions, etc.

PARIS, KY.—The Paris-Carlisle-Maysville Traction Company, of which James N. Kehoe, of Maysville, is president, has been granted a franchise to enter Paris by a route and upon streets to be designated by the city council. The work of construction is to begin within eighteen months and to be finished in three years. The Fiscal Court granted the company a franchise from Paris to the

Nicholas county line. The Traction company and the county will cooperate in the building of an iron bridge over Stone creek at the foot of Main street, sixty feet wide, for foot passenges and vehicular traffic, with the traction company's lines in the centre.

HARTFORD, CT.—The incorporators of the Hartford & Middletown Street Railway Company have perfected organization. John Tregoning, of New Haven, has been elected president; John B. Crawford, of Hartford, secretary, and Norman Crawford, of Hartford, treasurer. The company has a valuable franchise to build a street railway from Wethersfield through Rocky Hill, Cromwall, Middletown, Durham, Middlefield, Guilford, North Branford and North Haven to a connection with the New Haven street railway system. At Wethersfield the line will connect with the Hartford trolley system, and the road will make a through trolley route from Hartford to Middletown and thence to New Haven. The line will run through a succession of populous communities. The authorized capital stock of the corporation is $500,000. Preliminary surveys will be made and a layout will be established in order to secure data on which to obtain approximate estimates as to the cost of the enterprise. It is doubtful, however, if construction will be undertaken this season.

NEW INCORPORATIONS.

LE MARS, IOWA—Le Mars Telephone Company. $100,000.

MALLARD, IOWA—Mallard Mutual Telephone Company. $12,000.

RIDGEWAY, IOWA—Madison Township Telephone Company. $2,000.

OXFORD MILLS, IOWA—Linn Electric Light and Power Company. $35,000.

HARRISBURG, PA.—Greencastle Light, Heat and Power Company. $10,000.

OBITUARY NOTICES.

MR. HEBER C. ROBINSON, sixty-five years old, one of the best-known residents of Camden, N. J., died suddenly August 20 of heart disease. Mr. Robinson was one of the pioneer telegraphers and electricians of Philadelphia, Pa. At the outbreak of the Civil War he was a member of the staff of private operators for President Lincoln.

MR. M. DWIGHT MUNGER, one of the early promoters of electrical operations, died on Saturday, August 19, at his home in Canandaigua, N. Y. Mr. Munger was born in Connecticut in March, 1830. He received his early education at the Canandaigua Academy, his family having located at that place in 1836. After various experiences in business he promoted the First National Bank, of Canandaigua, in 1864, and was cashier of this bank until it closed in 1887. During the years from 1876 to 1893 he was president and manager of the Canandaigua Gas Light Company. In 1888 he bought out the Excelsior Electric Light Company, which was reorganized as the Canandaigua Electric Light Company, of which he was manager until 1897, when he sold the controlling interest to capitalists, who afterward organized the Ontario Light and Traction Company. He was for three years president of the Canandaigua Steamboat Company, and was president of the Board of Trade.

MR. GUTHRIE GRAY—The death of Mr. Guthrie Gray, at Muskoka Lake, on August 26, has cut short at the early age of thirty-one years the career of one whose future was full of promise. Mr. Gray was graduated from the Lawrence Scientific School of Harvard University in the class of 1896, and was an electrical engineer of more than ordinary ability. After his graduation he was for a number of years employed in the engineering department of the Buffalo General Electric Company, whose employ he left to accept a position under Mr. Henry Rustin, the superintending engineer in charge of the extensive lighting system of the Pan-American and St. Louis expositions. For the past two years Mr. Gray has been employed in the engineering department of the National Battery Company, of Buffalo, N. Y., and in the short time that he had been connected with this company his energetic work and cheerful disposition had gained him the high esteem of the management and his business associates. At the time of his death Mr. Gray was a member of the American Institute of Electrical Engineers.

PERSONAL MENTION.

MR. WILLIAM C. ANDERSON has been appointed general manager of the Wyoming Valley Gas and Electric Company, to succeed Mr. A. C. Swain.

MR. WALTER L. STEVENS has been appointed district manager of the Michigan State Telephone Company, taking charge of the Jackson (Mich.) exchange. Mr. Stevens, who has recently been chief clerk at the Michigan state prison, was formerly connected with the Bell Telephone Company, and was collector and chief operator in the Jackson exchange, finally being promoted to the office of manager at Dowagiac.

MR. ALBERT B. BOHON has been appointed electrical inspector of Louisville, Ky., to succeed Mr. Frank W. Parfitt, who died recently. Mr. Bohon is a native of Louisville, and until his appointment was an employé of the Cumberland Telephone and Telegraph Company, beginning operations with this company about twenty-five years ago. About ten years ago he went East, and became superintendent of the New Jersey Telephone and Telegraph Construction Company, retaining this position until four years ago, when he returned to Louisville, becoming again identified with the local company.

ELECTRICAL SECURITIES.

Notwithstanding a decided reaction toward the latter end of the week there were three million-share days, and the tone of the market was anything but apprehensive. The early sessions of the present week, however, witnessed a decided slump in several of the leading railway and industrial securities. Over the Saturday and Sunday holiday the complexion of the peace conference entirely changed, and notwithstanding the fact that there was greater hope of a peaceful ending to the meeting of the envoys the market sagged considerably. The general industrial conditions continue to be good, and indications are that there will be a further revival of prosperous times. The improvement in the iron and steel trade is noticeable, and the prosperity of the transportation interests is conceded in all quarters.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 26.

New York:	*Closing.*
Brooklyn Rapid Transit	71⅛
Consolidated Gas	187
General Electric	182
Interborough Rapid Transit	213¼
Kings County Electric	200
Manhattan Elevated	166½
Metropolitan Street Railway	132¼
New York & New Jersey Telephone	167
Westinghouse Manufacturing Company	180

During the month of July, the first month of the new fiscal year, the gross earnings of the Brooklyn Rapid Transit Company increased $250,000 over the corresponding month in 1904.

Boston:	*Closing.*
American Telephone and Telegraph	146¾
Edison Electric Illuminating	255
Massachusetts Electric	61½
New England Telephone	134¼
Western Telephone and Telegraph preferred	97½

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	84¾
Electric Storage Battery preferred	84¾
Philadelphia Electric	8⅛
Philadelphia Rapid Transit	28⅛
United Gas Improvement	99

Chicago:	*Closing.*
Chicago Telephone	133
Chicago Edison Light	155
Metropolitan Elevated preferred	65½
National Carbon common	62
National Carbon preferred	115½
Union Traction common	7½
Union Traction preferred	35

INDUSTRIAL ITEMS.

THE AMERICAN PLATINUM WORKS, Newark, N. J., has favored some of its friends with a handsome ebonized fifteen-inch ruler; a most practicable gift.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, in the current issue of its pigeon-hole folder, calls attention to the application of Peerless motors to printing machinery.

THE BALL ENGINE COMPANY, Erie, Pa., in catalogue "O" describes and illustrates its latest types of side-crank engines. This is an entirely new line of both horizontal and vertical engines.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Minneapolis, Minn.; Louisville, Ky.; Gilbert Station, Iowa; Rochester, N. Y., and Miami, Fla.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has prepared a new form of handy graphite rope dressing for application to a cable or rope while in motion. This graphite is put up in the form of cakes containing about three pounds of graphite lubricant.

THE SPRAGUE ELECTRIC COMPANY, New York city, in bulletin No. 223 describes its type N motors specially designed for crane service. These motors possess special features of design and construction, full information concerning which may be had by addressing the company.

STANLEY & PATTERSON, INCORPORATED, 40 Cortlandt street, New York city, is calling attention to the "Faraday" skeleton bell in a neat mailing card. The "Faraday" bell embodies some radical features of construction, which the company will be pleased to explain fully upon request.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has placed on the market a special line of form L small motors, in outputs from one-quarter to three horse-power. They may be used for either belt or direct-drive and may be fitted with end-shields, rendering them dustproof. They are adapted for either wall or ceiling suspension. These motors are described and illustrated in bulletin No. 60, recently issued, which may be secured upon request.

BAKER & COMPANY, INCORPORATED, refiners and manufacturers of platinum, Newark, N. J., and New York city, are making extensive additions to their Newark works. The rapidly increasing consumption of platinum in the industrial arts has made this extension necessary, especially in their refining department, which will be enlarged over 100 per cent. New and larger offices are also being erected, and the entire plant equipped with the most modern appliances for the economical manufacture of their varied and high-grade products.

THE H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., has issued a catalogue descriptive of 600-volt protective devices, the well-known "Noark" enclosed fused and fuse devices being fully illustrated. The data are very complete and the text takes up the operation and design of each piece of apparatus. This 600-volt catalogue is one of a series of three, the other two being devoted to 250-volt and 1,500-10,000-volt devices. The three books, when combined, comprise a complete line of fuse devices, suitable for all voltages.

THE CRESCENT ELECTRICAL MANUFACTURING COMPANY, Rochester, N. Y., has found it necessary, owing to the rapid growth of its business, to secure additional factory space for its regular line of specialties, and has added to its list the manufacture of panel-boards. This department has been placed in charge of an experienced switch and panel-board designer. With new and improved machinery the company feels fully competent to supply the best grade of material at reasonable prices. The company will, from time to time, add other specialties to its present list of manufactures.

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., has just completed the erection of a large shop designed to provide for its rapidly increasing business. This company not only supplies special exhausters with bearings removed from the action of the flue gases for mechanical draught in connection with the Green fuel economizer, but also builds fans, blowers and exhausters for every purpose, having, for instance, recently sold fans for heating, ventilating and humidifying in textile mills, ventilating and drying in paper mills, heating and ventilating in large buildings, etc., and is now installing one of the largest mechanical draught exhausters ever built for a factory in Massachusetts. New designs have been worked out for all types of "Green-Matteawan" fans with the special object of reducing the power required for driving. The Green Fuel Economizer Company does not contract for the engineering of plants, or for the installation of heating and ventilating plants in competition with the heating and ventilating contractors, but offers the advantages of its engineering skill and sixty years' experience in the construction and operation of air-moving plants.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, has booked the following orders: the Empire Plow Company, Cleveland, Ohio, a 100-kilowatt generator and motors aggregating 110 horsepower, for individual drive. The Kalamazoo (Mich.) Railway Supply Company is installing twenty-horse-power and thirty-five-horsepower Peerless motors. The Southard Novelty Company, Columbus, Ohio, has completed a model equipment consisting of a twenty-five-kilowatt generator and thirteen Peerless motors. Boston (Mass.) University is putting in two Peerless motors for laboratory duty, duplicating an equipment some time ago furnished the Massachusetts Institute of Technology. Printing-press individual drives have recently been supplied to the United States Indian Training School at Carlisle, Pa.; the Solvay Process Company, Solvay, N. Y., and the Glessner Medicine Company, Findlay, Ohio. An equipment that is attracting considerable attention is at the South Sharon (Pa.) Steel Works of the Carnegie Company, where one hundred Peerless motors are being used with great success on the conveyer system for handling steel from the rolls. The installation was designed by the Peerless Electric Company's engineers.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., through its foreign department, has secured orders for the following equipment in Mexico: the Pueblo Compania de Luz y Potencia has purchased two 220-volt induction motors, fifty and thirty-five horse-power, and four transformers of various capacities, for use on two 300-volt transmission lines stepping down to 220 volts for distribution. The City of Tepic will use two revolving-field, three-phase, 350-kilowatt, 6,600-volt generators and two twenty-two-kilowatt, twenty-five-volt exciters, together with generator and substation switchboard and small transformers aggregating 650 kilowatts. The Mexican Light and Power Company has ordered one feeder panel and one mercury arc rectifier panel for its El Oro substation. The Guanajuato Power and Electric Company has purchased a horizontal revolving-field, three-phase, 3,000-kilowatt, 2,300-volt alternator for direct-connection to water-wheel and four water-cooled, sixty-cycle, 1,080-kilowatt transformers stepping up to 60,000 volts for line transmission, and four sixty-cycle, water-cooled, 970-kilowatt transformers stepping down to 15,700 volts from the line potential supplied by the first four transformers. In the same city the Guanajuato Reduction and Mining Company has ordered eight induction motors of various sizes, aggregating 375 horse-power for use on 440-volt circuits.

AUTOMOBILE NOTE.

THE AUTOMOBILE LAW—The Automobile Club of America is distributing a copy of a decision by the Hon. Nicholas C. Downs, city judge for the city of Stamford, Ct., on the spirit and not the letter of the automobile law. This is a prosecution for a violation of section 2,089, which provides that a motor vehicle shall not be run on any highway or public place at a speed dangerous to life and property; or on any highway or public place outside the limits of the city or borough at a rate of speed to exceed fifteen miles per hour; or on any highway or public place within the limits of the city or borough at a rate of speed to exceed twelve miles an hour. The memorandum states that it is apparent that the purpose of the statute is to prevent the running of motor vehicles in such a manner as to endanger persons or property. The decision contains a very interesting commentary upon the provisions for keeping within the speed limits, and makes an analysis of the technical degree of the offence committed in violation of this statute.

MARSDEN J. PERRY

PRESIDENT, NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

Mr. Perry is a very prominent figure in the electric lighting, electric traction and financial interests of Rhode Island. He is also interested in public service corporations in New York and Massachusetts. Mr. Perry was president of the National Electric Light Association, 1890-1891.

ERNEST H. DAVIS

GENERAL MANAGER, EDISON ELECTRIC ILLUMINATING COMPANY, WILLIAMSPORT, PA.

Mr. Davis, while still a young man, has long been connected with central station management, and was president of the National Electric Light Association 1904-1905. He is also general manager of a number of other electric lighting and traction companies, located in Pennsylvania.

W. J. WILGUS

VICE-PRESIDENT, NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY, NEW YORK CITY.

Mr. Wilgus is at the head of the company's electrical commission, having for his associates John F. Deems, Bion J. Arnold, Frank J. Sprague, George Gibbs and Edwin B. Katte. Mr. Wilgus's work is attracting the attention of steam railroad men in general.

H. T. HARTMAN

SECOND VICE-PRESIDENT, ELECTRIC COMPANY OF AMERICA, PHILADELPHIA, PA.

Mr. Hartman is also chief engineer and a director of the Electric Company of America, and is a vice-president and chief engineer of a number of other prominent electric lighting and traction interests in Pennsylvania, controlled by the Electric Company of America. He is also interested in various heating and power companies in other parts of the United States.

WILLIAM HENRY BAKER

VICE-PRESIDENT AND GENERAL MANAGER, POSTAL TELEGRAPH-CABLE COMPANY, NEW YORK CITY.

Mr. Baker is one of the pioneer operating telegraph men, and is the able general manager of an extremely well conducted and extensive system of communication. He is a director of a number of telegraph and cable companies, including the Commercial Union Telegraph Company, and the Pacific Postal Telegraph-Cable Company.

EDWARD F. PECK

GENERAL MANAGER, SCHENECTADY RAILWAY COMPANY, SCHENECTADY, N. Y.

Mr. Peck has been in the electrical field since 1880. In 1885 he took charge of the Citizens' Electric Illuminating Company, of Brooklyn. In 1897, general superintendent, Kings County Electric Light and Power Company. Chairman, executive committee, Street Railway Association of the State of New York.

P. O. KEILHOLTZ

ENGINEER, CONSOLIDATED GAS, ELECTRIC LIGHT AND POWER COMPANY, BALTIMORE, MD.

Mr. Keilholtz designed and supervised the construction of the buildings of the United Railways and Electric Company, which withstood the recent conflagration in Baltimore. He is head of the electrical and mechanical departments of the United Railways, and of the operating department of the Consolidated Gas, Electric Light and Power Company.

ALDEN M. YOUNG

PRESIDENT, CONNECTICUT RAILWAY AND LIGHTING COMPANY, BRIDGEPORT, CT.

Mr. Young has very extensive interests in the electrical field, and since the days of the telegraph has been an earnest and successful advocate of electrical progress. He is first vice-president of the Kings County Electric Light and Power Company; president, Rockville Gas and Electric Company, and the New England Engineering Company, and numerous other corporations. Mr. Young was president of the National Electric Light Association, 1898-1899.

EDGAR C. BRADLEY

SECOND VICE-PRESIDENT, POSTAL TELEGRAPH-CABLE COMPANY, NEW YORK CITY.

Mr. Bradley entered the telegraphic service of the Michigan Central Railroad in 1870, at the age of fifteen. He has been intimately connected with the telegraph service ever since, and was appointed assistant general manager of the Postal Telegraph-Cable Company in 1892, later becoming second vice-president.

CHARLES L. EDGAR

PRESIDENT, EDISON ELECTRIC ILLUMINATING COMPANY, BOSTON, MASS.

Mr. Edgar has taken a prominent part in the development of the Edison Electric Illuminating interests. For three terms Mr. Edgar was president of the Association of Edison Illuminating Companies. He was president of the National Electric Light Association, 1903-1904.

J. C. BARCLAY

ASSISTANT GENERAL MANAGER, WESTERN UNION TELEGRAPH COMPANY, NEW YORK CITY.

Mr. Barclay's duties embrace also those of electrical engineer for the entire system of the Western Union Telegraph Company. Mr. Barclay has contributed many improvements in telegraph apparatus, and is the inventor of a printing telegraph system in everyday use on the lines of the company.

J. B. McCALL

PRESIDENT, THE PHILADELPHIA ELECTRIC COMPANY, PHILADELPHIA, PA.

The Philadelphia Electric Company owns and controls all of the electric lighting properties in the city of Philadelphia. Mr. McCall, aside from a very busy life in managing and developing his important Philadelphia interests, is president of the Association of Edison Illuminating Companies, and devotes much time to its affairs.

JAMES B. HOGE

SECRETARY, UNITED STATES LONG-DISTANCE TELEPHONE COMPANY, CLEVELAND, OHIO.

Mr. Hoge is one of the most prominent figures in the independent telephone field. He is a successful financier, and has been interested in the establishment of independent telephone exchanges since 1894. He is also secretary of the Cuyahoga Telephone Company, and is president of the National-Interstate Telephone Association.

THOMAS EDWARD MURRAY

SECOND VICE-PRESIDENT AND GENERAL MANAGER, NEW YORK EDISON COMPANY, NEW YORK CITY.

Mr. Murray has been actively engaged in the operating and engineering work of central stations for the last twenty years. He has been consulting engineer to several of the largest central stations in the country and is now in intimate direction of the affairs of a number of public service corporations.

RALPH PETERS

PRESIDENT AND GENERAL MANAGER, THE LONG ISLAND RAILROAD COMPANY, LONG ISLAND CITY, N. Y.

Mr. Peters is a director in the many allied companies of this railroad. These companies represent, to a considerable extent, all of the electrification on Long Island. The Long Island Railroad Company has recently put in operation a heavy system of electric traction, which is being watched with great interest.

UNION N. BETHELL

VICE-PRESIDENT AND GENERAL MANAGER, NEW YORK TELEPHONE COMPANY, NEW YORK.

President, Chesapeake & Potomac Telephone Company; Bell Telephone Company, Philadelphia; New York & New Jersey Telephone Company, and a number of other companies operating in the eastern territory covering over 72,000 square miles, in which over 500,000 Bell telephones are in use. Mr. Bethell is systematic, tactful and far-seeing in the conduct of the great properties he controls.

FREDERIC NICHOLLS

VICE-PRESIDENT AND GENERAL MANAGER, CANADIAN GENERAL ELECTRIC COMPANY, TORONTO, CANADA.

Mr. Nicholls is one of the foremost business men of the Dominion of Canada. He is president, vice-president or director of thirty manufacturing and commercial concerns, including the Canadian General Electric Company, and the Electrical Development Company of Ontario, Limited. He was president of the National Electric Light Association, 1896-1897.

JOHN W. LIEB, JR.

THIRD VICE-PRESIDENT AND ASSISTANT GENERAL MANAGER, NEW YORK EDISON COMPANY, NEW YORK CITY.

Mr. Lieb is one of the pioneers in electric lighting and traction, and has attained considerable prominence in engineering, both at home and abroad. He is a past-president of the Association of Edison Illuminating Companies and the New York Electrical Society. He has also been vice-president of the National Electric Light Association, and was president of the American Institute of Electrical Engineers, 1904-1905.

OPERATING ELECTRICAL MEN

W. H. BLOOD, JR.

ENGINEERING DEPARTMENT, SEATTLE ELECTRIC COMPANY, SEATTLE, WASH.

Mr. Blood is president of the National Electric Light Association, and a prominent figure in the Stone & Webster organization. He is connected with the Seattle Electric Company in both an engineering and a business capacity. He has been connected with the Stone & Webster interests since 1897.

W. F. WELLS

GENERAL SUPERINTENDENT, EDISON ELECTRIC ILLUMINATING COMPANY, BROOKLYN, N. Y.

Mr. Wells has long been connected with central station practice. In June, 1894, he was made electrical superintendent of the Edison Electric Illuminating Company of Brooklyn, and he represents the younger generation of progressive central station managers.

GEORGE GRAY WARD

VICE-PRESIDENT AND GENERAL MANAGER, COMMERCIAL CABLE COMPANY, NEW YORK CITY.

Mr. Ward has been intimately connected with telegraph service since his early boyhood. In 1884 he was made secretary and general manager of the Commercial Cable Company. In 1890 he was elected vice-president. He was active in organizing the Commercial Pacific Cable Company.

CHARLES R. HUNTLEY

VICE-PRESIDENT AND GENERAL MANAGER, BUFFALO GENERAL ELECTRIC COMPANY, BUFFALO, N. Y.

Mr. Huntley is one of the pioneer electrical men. He has served as chairman of the executive committee of the National Electric Light Association, and was elected president at the Providence convention, held in February, 1891. Mr. Huntley is a prominent citizen of Buffalo, identified with all progressive movements.

LOUIS A. FERGUSON

SECOND VICE-PRESIDENT, CHICAGO EDISON COMPANY AND COMMONWEALTH ELECTRIC COMPANY, CHICAGO, ILL.

Mr. Ferguson has had a wide experience in central station operation, beginning with the Chicago Edison Company in 1889. Mr. Ferguson was president of the Association of Edison Illuminating Companies 1901-1902 and 1902-1903, and president of the National Electric Light Association 1902-1903.

HERBERT H. VREELAND

PRESIDENT, NEW YORK CITY RAILWAY COMPANY, NEW YORK CITY.

Mr. Vreeland is one of the most popular managers of street railway interests in the country, and his advice in this field is sought by managers in all parts of the country. He has been intimately connected with both steam and electric railroad propositions for many years. He is also president of a number of other traction companies.

ANGUS S. HIBBARD

VICE-PRESIDENT AND GENERAL MANAGER, CHICAGO TELEPHONE COMPANY.

Mr. Hibbard is one of the recognized pioneer telephone men. He was prominently associated with the Wisconsin Telephone Company in the early days, with headquarters at Milwaukee, afterward residing in New York city as general superintendent of the American Telephone and Telegraph Company (long-distance). Mr. Hibbard's work has been important, progressive and broad-gauged.

ROBERT C. CLOWRY

PRESIDENT, WESTERN UNION TELEGRAPH COMPANY, NEW YORK CITY.

Mr. Clowry began his career in telegraphy in the service of the Illinois & Mississippi Telegraph Company in 1852. In 1866 he was appointed district superintendent of the Western Union Telegraph Company's lines in the Southwest, after a brilliant career in the Civil War, from which he retired with the title of colonel. In October, 1885, he was elected a director, a member of the executive committee and a vice-president of the Western Union company. He was elected president in 1902.

GEORGE B. TRIPP

GENERAL MANAGER, COLORADO SPRINGS ELECTRIC COMPANY, COLORADO SPRINGS, COL.

Mr. Tripp has managed the property of the Colorado Springs Electric Company for the past four years. This company controls the El Paso Electric Company and the Citizens' Light, Heat and Power Company. Mr. Tripp is also the manager of the Colorado Springs Light and Power Company. He is secretary of the Colorado Electric Light, Power and Railway Association.